
GREAT IS THAT
THE GIFT
BRINGETH KNOWLEDGE
ESSE QUAM VIDERI

62d Congress, 2d Session | HOUSE OF REPRESENTATIVES | Document No. 391

INTRACOASTAL WATERWAY

BOSTON, MASS., TO BEAUFORT, N. C. SECTION

LETTER FROM
THE SECRETARY OF WAR

TRANSMITTING

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON SURVEY OF THE BOSTON, MASS., TO BEAUFORT, N. C., SECTION OF THE PROPOSED CONTINUOUS INLAND WATERWAY FROM BOSTON, MASS., TO THE RIO GRANDE

January 5, 1912.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations

WASHINGTON
GOVERNMENT PRINTING OFFICE
1912

LETTER OF TRANSMITTAL.

War Department,
Washington, January 4, 1912.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated 2d instant, together with copy of report by a special board of Engineer officers, dated October 4, 1911, with maps, of a survey of that section of the proposed continuous inland waterway from Boston, Mass., to the Rio Grande, from Boston, Mass., to Beaufort, N. C., made in compliance with a provision contained in the river and harbor act of March 3, 1909.

Very respectfully,

H. L. Stimson,
Secretary of War.

The Speaker of the House of Representatives.

REPORT ON INTRACOASTAL WATERWAY—BOSTON, MASS., TO BEAUFORT, N. C., SECTION.

War Department,
Office of the Chief of Engineers,
Washington, January 2, 1912.

Sir: 1. I have the honor to forward herewith, for transmission to Congress, a report dated October 4, 1911, prepared by a special board of Engineer officers in accordance with a provision contained in the river and harbor act approved March 3, 1909, as follows:

Sec. 13. * * * The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the localities named in this section, as hereinafter set forth.

* * * * * * *

Survey for the construction of a continuous waterway, inland where practicable, from Boston, Massachusetts, to Long Island Sound including a waterway from the protected waters of Narragansett Bay through the ponds and lagoons lying along the southern coast of Rhode Island to Watch Hill and Fishers Island; thence to New York Bay; thence across the State of New Jersey to a suitable point on Delaware River or Bay; thence to Chesapeake Bay; thence from Norfolk, Virginia, to the sounds of North Carolina and Beaufort Inlet, North Carolina, for the purpose of ascertaining the cost of a channel with a maximum depth of twenty-five feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

2. The report of this special board has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, to whose report herewith, dated December 12, 1911, attention is invited.

3. After careful consideration of these reports and in accordance with the instructions of Congress, I report upon this subject that I concur in general with the views expressed by the Board of Engineers for Rivers and Harbors, and that I deem advisable at the present time the adoption of projects as follows:

First. The construction of a waterway 12 feet deep between Norfolk, Va., and Beaufort Inlet, N. C., at a total cost, in round numbers, of $5,400,000, itemized as follows:

	12-foot depth.
Norfolk to Albemarle Sound: Albemarle & Chesapeake Canal route	$2, 735, 000
Albemarle Sound to Pamlico Sound: Rose Bay route	2, 215, 000
Brant Shoal Cut	55, 000
Pamlico Sound to Beaufort Inlet: Via Adams Creek Canal	395, 000
Total for 12-foot depth	5, 400, 000

The amount estimated for the section from Norfolk to Albemarle Sound includes $500,000 for the purchase of the existing Albemarle & Chesapeake Canal and $2,235,000 for its improvement and increase in depth to 12 feet; and an immediate appropriation of $735,000 for such purchase and commencement of work with authorization of $2,000,000 additional to secure 12-foot depth, is recommended.

Subsequent to the enactment of the law which provided for this survey the Secretary of War was authorized by the act of June 25, 1910, to make a contract for the purchase of either the Albemarle & Chesapeake Canal or the Dismal Swamp Canal, subject to future ratification and appropriation by Congress. It was further provided "that no contract for the purchase of either of said canals shall be made unless such purchase, after full hearing of all parties in interest, is recommended in the survey report to be hereafter submitted in compliance with the directions of Congress in the river and harbor act approved March 3, 1909." Since all parties in interest have had full hearing and since the purchase of the Albemarle & Chesapeake Canal is recommended in this survey report, a recommendation will be promptly made by me to the Secretary of War that a contract be entered into for the purchase of the Albemarle & Chesapeake Canal, subject to future ratification and appropriation by Congress as provided for in the act of June 25, 1910. The purchase of this canal and the freeing of the present commerce between Norfolk and Albemarle Sound of the tolls now charged will of itself alone be of considerable aid to commerce. It is recommended that the improvement of the entire section from Norfolk, Va., to Beaufort Inlet, N. C., be commenced as soon as title to the canal property has been obtained by the United States with a view to the completion of the 12-foot depth over the entire route within six years.

Second. The immediate purchase of the existing Chesapeake & Delaware Canal, which connects Chesapeake Bay with the Delaware River, at an estimated cost of $2,514,290, and its progressive change to a tide-level canal of 25 feet depth at mean low water at a further cost of $9,910,210, making a total initial cost of $12,424,500, of which $3,000,000 should be made available immediately, and the rest be covered by authorizations with a view to final completion, following the general line of improvement outlined by the special board. This canal forms an essential part of a through inland waterway connecting New York and Philadelphia with the South. Its purchase and the abolishment of tolls will produce at once a considerable saving in transportation expenses and should result in an early and substantial increase of traffic with advantage to the commerce of several States. This canal is at present 10 feet deep and of the lock type, the locks being 24 feet wide by 220 feet long. The change should be made gradually and in such way as to interfere as little as possible with existing traffic; and 12 feet depth or thereabout should be secured throughout the canal before the deepening is carried to 25 feet. While the above recommendation for immediate purchase of this canal and the enlargement of this section to about 12 feet depth is a definite recommendation, the method of deepening to 25 feet and the rapidity of work for the first and subsequent deepening must depend considerably upon the cost of the intermediate steps, and further estimates for such portions of the work will therefore be called for and submitted later with final recommendation for this section.

4. The special board recommended the construction of a sea-level canal 25 feet deep across the State of New Jersey between the Delaware River and Raritan Bay at a cost estimated at $45,000,000. To aid in carrying out this project the State of New Jersey has undertaken to provide not to exceed $500,000 for purchase of right of way for the canal. The special board stated, however, that the construction of the canal recommended should be deferred until after the construction of the two more southerly sections (Delaware-Chesapeake and Norfolk-Beaufort sections), and until the necessary plant now at work on the Panama Canal shall be made available.

The Board of Engineers for Rivers and Harbors states that it is not convinced that a canal of much less depth than 25 feet would not adequately meet the demands of commerce, and believes that estimates of cost of a canal 12 feet deep should be made. Orders have been already issued that such estimates be prepared and that the subject of improvement of this portion of the proposed waterway be further considered. After such estimates have been received and considered, my recommendations as to this portion of the route will be submitted. This development will be of so great direct local benefit to the State of New Jersey that a liberal contribution from such State seems proper in addition to its supply of the right of way.

5. With respect to the section of the through route between Fishers Island and New York Bay, it may be stated that the conditions affecting navigation are such that that section is in its natural condition practically a sheltered inland waterway of ample capacity for all the traffic that will ever use it except at the western end where certain obstructions exist which are being removed under projects now in effect and for which any needed further improvement will be recommended in a report to be made in compliance with another item of the act of March 3, 1909, which provided for an examination of "East River including Little Hell Gate."

6. For the section between Narragansett Bay and Long Island Sound, the special board recommended the construction of a canal 18 feet deep between Fishers Island Sound and Bissells Cove, Narragansett Bay, with an additional entrance 18 feet deep just north of Narragansett Pier at an estimated cost of $12,322,000, but stated that the full benefit to be derived from the construction of this canal can be obtained only on the completion of the sections to the south, and that the initiation of the work should follow that on the New Jersey section. The State of Rhode Island has undertaken to provide a free right of way for the canal as far as can be provided with an appropriation of $500,000. The Board of Engineers for Rivers and Harbors states that it is very questionable whether the inside route would be used sufficiently to warrant the large expenditure required for its construction and maintenance and that it is not advisable to commit the Government at this time to a definite project for the execution of this work. I concur with the views of the Board of Engineers for Rivers and Harbors, and as required by law express my opinion that it is not advisable for the Government to undertake the construction of this link of the proposed waterway at the present time.

7. For the section of the proposed waterway between Boston and Narragansett Bay the special board prepared approximate estimates for canals starting at Narragansett Bay; one was for a canal 18 feet

in depth via Taunton and Plymouth to cost about $17,500,000 and another for a canal 25 feet in depth via Taunton and Hingham to cost about $40,000,000, and also considered the advisability of the purchase by the United States at this time of a canal now being constructed by private parties to connect Buzzards Bay with Cape Cod Bay which will shorten materially the distance between Long Island Sound and Boston. A commission appointed by the State of Massachusetts "to consider in what manner the Commonwealth may best cooperate with the Federal Government and certain other States in the development of inland waterways," has reported that "The conditions of transportation may so change in the future as to make such a canal desirable and necessary, but the facts as they now appear do not warrant this commission in advocating the present construction of the proposed canal." I concur with the views of the special board and the Board of Engineers for Rivers and Harbors that at the present time there is no commercial necessity sufficient to justify the construction of a canal over either of the inland routes above mentioned, and that it is not considered by me advisable for the United States to undertake at this time the construction of such a canal or to enter into negotiations for acquisition of the Cape Cod Canal now in course of construction by private parties.

8. Attention is invited to the remarks of the special board as to the desirability of such legislative or municipal action as will insure the preservation of suitable sites for terminal facilities free from monopoly and the cooperation of transportation companies operating by rail and by water, the remarks of the board on this subject being as follows:

Similarly, it has been a policy of the railway companies to obtain possession as far as possible of all available wharf space in terminal cities, partly with a view to preventing competition. The recent movement toward providing adequate public wharf space in the cities will counteract this evil. Further, in many cases railways have been so operated as to throw obstacles in the way of dividing a long-distance carriage between rail and water, and thus to make an all-rail carriage most advantageous. This has been done by increasing the difficulties and costs of transfer between the rail and water carriers, by refusing to make or honor through bills of lading over mixed rail and water routes, or by making charges for short hauls by rail for distribution from water terminals prohibitively high. Since the railways are quasi-public institutions, owing their possibility of existence to important public rights granted by law, it is certain that a policy of this kind which is manifestly contrary to the public interests must eventually be changed. Until action has been taken by the Nation and States which will insure cooperation between transportation companies operating by rail and by water and thus provide for the interchange of commerce at the minimum of expense to the public, the full benefits to be obtained from the improvement of waterways can not be had, and the benefits received must be measured mainly by the lowering of rail freight rates to favored communities located on water routes.

Very respectfully,

W. H. Bixby,
Chief of Engineers, U. S. Army.

The Secretary of War.

[For report of Board of Engineers for Rivers and Harbors, see p. 268.]

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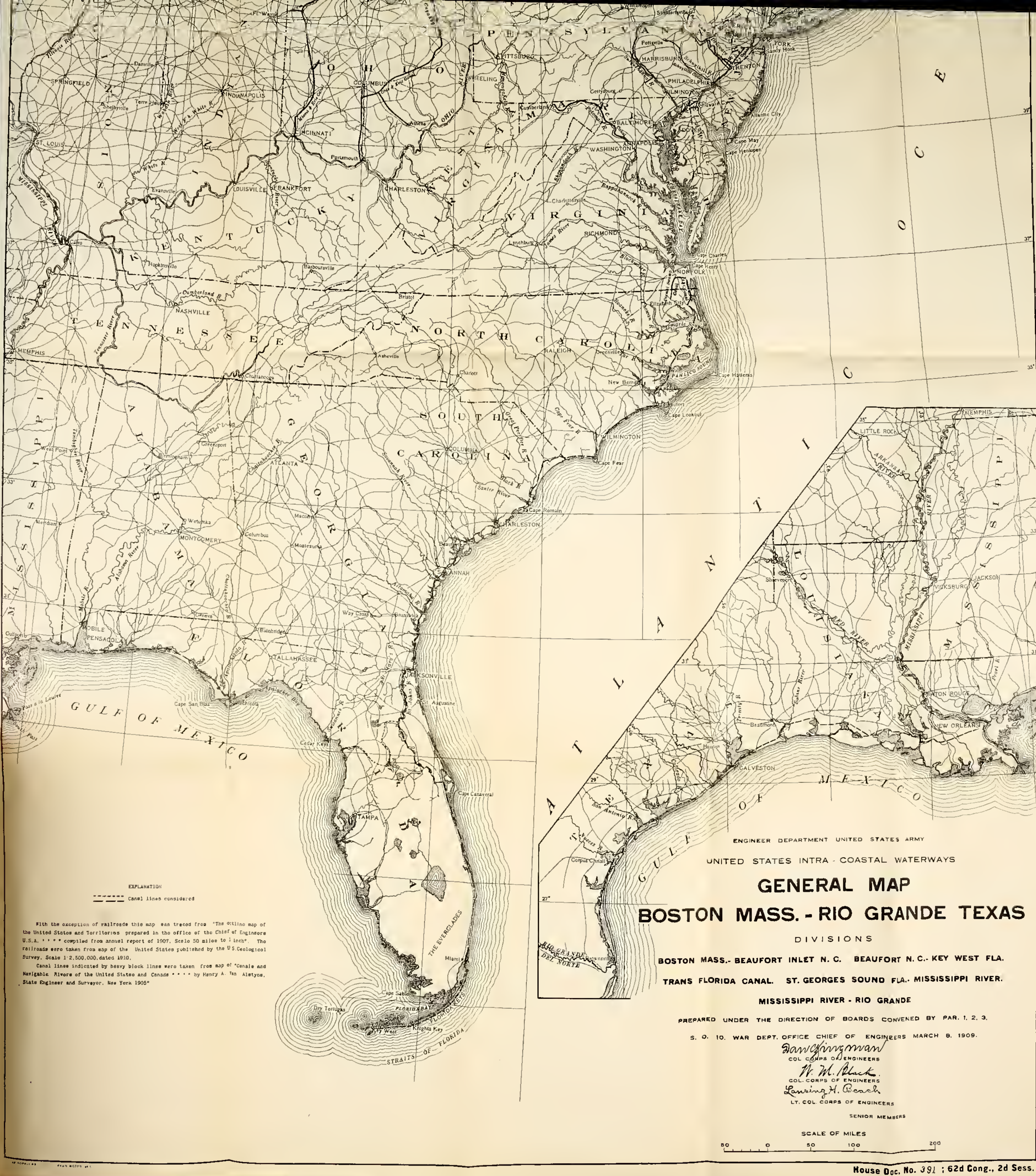


House Doc. No. 391 ; 62d Cong., 2d Sess.

SURVEY OF THE BOSTON, MASS., TO BEAUFORT, N. C., SECTION OF THE PROPOSED CONTINUOUS INLAND WATERWAY FROM BOSTON, MASS., TO THE RIO GRANDE.

War Department,
United States Engineer Office,
New York, N. Y., October 4, 1911.

Sir: The board appointed by paragraph 1, Special Orders, No. 10, dated March 8, 1909, from the office of the Chief of Engineers, as amended by Special Orders, No. 34, dated July 13, 1909; No. 5, dated February 12, 1910; and No. 24, dated May 31, 1910, from the office of the Chief of Engineers, to make a survey for a continuous inland waterway from Boston, Mass., to Beaufort, N. C., and submit a report thereon as prescribed in the river and harbor act approved March 3, 1909, has the honor to submit the following report:

Report on Boston-Beaufort Inlet Division, Proposed Intracoastal Waterway.

The river and harbor act approved March 3, 1909, contains the following clauses governing the preparation of a project for an intracoastal waterway:

Sec. 13. * * * The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the localities named in this section, as hereinafter set forth.

* * * * * * *

Survey for the construction of a continuous waterway, inland where practicable, from Boston, Massachusetts, to Long Island Sound, including a waterway from the protected waters of Narragansett Bay through the ponds and lagoons lying along the southern coast of Rhode Island to Watch Hill and Fishers Island; thence to New York Bay; thence across the State of New Jersey to a suitable point on Delaware River or Bay; thence to Chesapeake Bay; thence from Norfolk, Virginia, to the sounds of North Carolina and Beaufort Inlet, North Carolina, for the purpose of ascertaining the cost of a channel with a maximum depth of twenty-five feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

Survey for the construction of a continuous waterway, inland where practicable, from Beaufort, North Carolina, to the Cape Fear River, North Carolina; thence to Winyah Bay, South Carolina; thence to Saint Johns River, Florida; thence to Key West, Florida, for the purpose of ascertaining the cost of a channel with a maximum depth of twelve feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

Survey for the construction of a continuous inland waterway across the State of Florida, between suitable points on the eastern and Gulf coasts of said State, for the purpose of ascertaining the cost of a channel with a maximum depth of twelve feet, or such lesser depths along any section or sections of said waterway as may be found sufficient for commercial, naval, and military purposes. Such survey shall include

an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

Survey for the construction of a continuous waterway, inland where practicable, along the Gulf of Mexico from Saint Georges Sound, Florida, to the Mississippi River at New Orleans, Louisiana, by way of Saint Andrews Bay, Choctawhatchee Bay, Pensacola Bay, and Perdido Bay, Florida; Mobile Bay, Alabama; Mississippi Sound, Alabama and Mississippi; Lake Borgne and Lake Pontchartrain, Louisiana, for the purpose of ascertaining the cost of a channel with a maximum depth of nine feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

Survey for the construction of a continuous inland waterway in the State of California, between suitable points on Humboldt Bay and Eel River, with a view to obtaining a channel of suitable width and a maximum depth of nine feet, or such lesser depths along any section or sections of said waterway as may be found desirable. Such survey shall include an examination of all practicable routes.

INLAND WATERWAY OF LOUISIANA AND TEXAS.

Survey for the construction of a continuous inland waterway from the Mississippi River to Bayou Teche; thence to Mermentau River; thence to Calcasieu River; thence to the Sabine River, Louisiana and Texas; thence to Galveston, Texas; thence to Brazos River, Texas; thence to Pass Cavallo; thence to Aransas Pass; thence to Point Isabel; and thence to the Rio Grande, for the purpose of ascertaining the cost of a channel with a maximum depth of nine feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same: *Provided*, That whenever, in the making of a survey of any of the preceding waterways, field work shall indicate that the proposed improvement is clearly inadvisable, no detailed survey or plans shall be made.

By departmental ruling the following sentence of the last paragraph was held to apply to all the divisions of the intracoastal waterway above named:

Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same: *Provided*, That whenever, in the making of a survey of any of the preceding waterways, field work shall indicate that the proposed improvement is clearly inadvisable no detailed survey or plans shall be made.

In the river and harbor act approved June 25, 1910, the following additional legislation was enacted with reference to the Boston-Beaufort Inlet division:

Improving inland waterway from Norfolk, Virginia, to Beaufort Inlet, North Carolina: The Secretary of War is hereby authorized to enter into negotiations for the purchase, as a part of said inland waterway, of the Albemarle and Chesapeake Canal, or the Dismal Swamp Canal, together with all property, rights of property, and franchises appertaining thereto; and he is further authorized, if in his judgment the price is reasonable and satisfactory, to make a contract for the purchase of either of said canals and appurtenances, subject to future ratification and appropriation by Congress: *Provided*, That no contract for the purchase of either of said canals shall be made unless such purchase, after full hearing of all parties in interest, is recommended in the survey report to be hereafter submitted in compliance with the directions of Congress in the river and harbor act approved March third, nineteen

hundred and nine: *Provided further*, That said report shall include estimates of the total cost of the completion of each of said canals, including also the purchase price of each, with the advantages of each for commerce.

In compliance with these directions the Chief of Engineers, by authority of the Secretary of War, convened special boards of engineer officers to consider and report on each division of the intracoastal waterway named in the act.

By Special Orders, No. 10, War Department, office of the Chief of Engineers, Washington, March 8, 1909, paragraph 1, a board consisting of Col. William M. Black, Lieut. Col. Edw. Burr, Lieut. Col. James C. Sanford, Maj. Joseph E. Kuhn, and Capt. Lewis H. Rand was directed to perform the work for the division of the waterway from Boston, Mass., to Beaufort Inlet, N. C. Under date of July 13, 1909, Lieut. Col. (then Maj.) Mason M. Patrick was substituted for Maj. Joseph E. Kuhn; under date of February 12, 1910, Maj. R. R. Raymond was substituted for Capt. Lewis H. Rand; and under date of May 31, 1910, Col. F. V. Abbot was substituted for Lieut. Col. Edw. Burr, these changes having been necessitated by changes of stations and duties of the officers concerned.

The members of the board charged with the work of the Boston-Beaufort Inlet division made in person, from time to time, within the limits of the various sections, examinations of the proposed route or routes and considered all data obtained by the officers in local charge of the sections. After having maturely considered the entire subject the board submits the following as its conclusions as to the Boston-Beaufort Inlet division:

CONCLUSIONS.

Boston-Narragansett Bay section.—All practicable routes have been examined and two routes, which seemed to be the most practicable, were surveyed, starting at Narragansett Bay, one entirely inland from Taunton to Hingham and one inland from Taunton to Plymouth and thence from that point 30 miles via Massachusetts Bay to Boston. The advisability has also been considered of purchasing the partly completed Cape Cod Canal, which involves outside navigation from Fishers Island Sound all the way to Boston, except for a few miles in Buzzards Bay and in the 7 miles of canal proper On the two routes surveyed plans in detail sufficient to afford a basis for reliable estimates have been prepared for various depths, bottom widths, and heights of summit levels, with estimates of cost varying from $17,453,000 for a canal 18 feet deep with bottom width of 125 feet and summit level of 20 feet via Taunton and Plymouth, to $40,047,000 for a canal 25 feet deep with bottom width of 200 feet and summit level of 35 feet via Taunton and Hingham. At the present time there appears to be no commercial necessity sufficient to justify the construction of a canal over either of these inland routes. After other sections of the proposed intracoastal waterway have been constructed and after the measure of relief to commerce to be afforded by the Cape Cod Ship Canal has been demonstrated the question of the need for a completely sheltered waterway between Narragansett Bay and Boston should receive further consideration.

The economic value of the Cape Cod Canal, with its exposed approaches, has not yet been established. It is not considered advisable for the United States to enter into any negotiations looking to

the acquisition of this canal at the present time. After its completion the question of its acquirement, based on its value as a "going concern," may be worthy of further consideration.

Narragansett Bay-Long Island Sound section.—The only practicable route was examined and surveyed. No privately owned canal is available for purchase. This adopted route leaves Narragansett Bay at Bissells Cove and follows a series of tidal streams, ponds, and lagoons to Long Island Sound. A fair-weather entrance to the canal is also provided just north of Narragansett Pier. Plans in detail sufficient to afford a basis for reliable estimates have been prepared for various depths and widths, with the terminus at Bissells Cove, and also with a terminus just north of Narragansett Pier. They range from $11,399,205 for a canal 18 feet deep, with bottom width of 125 feet, terminating just north of Narragansett Pier, to $24,736,635 for a canal 25 feet deep, with bottom width of 250 feet, terminating at Bissells Cove, with an outlet 18 feet deep just north of Narragansett Pier.

A canal 18 feet deep, with 125 feet bottom width, terminating at Bissells Cove with an outlet 18 feet deep and 100 feet wide, just north of Narragansett Pier is recommended at an estimated cost of $12,322,000.

The full benefits to be derived from this section can be obtained only after the completion of the sections to the south, and initiation of work should follow that on the New Jersey section. The State of Rhode Island has undertaken to provide a free right of way for the canal, as far as an appropriation of $500,000 will permit. It is recommended that the State be requested to take such further steps as may be necessary to change the location of highways and roads as outlined in this report, the cost of the bridges only to be borne by the United States.

The commerce affected by this section of the Intracoastal Canal will be adequately served by a canal 18 feet deep and 125 feet clear bottom width.

New York Bay-Delaware River section.—All practicable routes have been examined, and those which seemed most suitable were surveyed. The advisability of purchasing the Delaware & Raritan Canal was also considered, and the purchase is not recommended. On the surveyed route which proved the most desirable plans in detail sufficient to afford a basis for reliable estimates were prepared for a lock canal and for a sea-level canal. A sea-level canal with a depth of 25 feet and a bottom width of 125 feet is recommended.

In the approach through Lower New York Bay the depth of 25 feet is proposed for a width of 100 feet, with a depth of 18 feet for an additional width of 200 feet. A channel of the same dimensions is proposed in the Delaware River between the end of the canal at Bordentown and deep water at Philadelphia. Between Bordentown and Trenton it is proposed to provide a channel 150 feet wide and 18 feet deep. The total estimated cost of construction is $45,000,000.

The State of New Jersey, by resolution of its legislature, has undertaken to expend not to exceed $500,000 toward providing a right of way for the canal. It is recommended that the State be requested to take such further steps as may be required to change the location of highways and roads to the extent which may be needed to carry

out the plans for the canal and to authorize the necessary changes in steam and electric railroad locations.

It is believed that the construction of this section of the canal should be deferred until after the construction of the two more southern sections and until the United States plant now at work in the Panama Canal shall be made available.

Delaware River-Chesapeake Bay section.—All practicable routes in this section were examined and the Back Creek route, along the line of the present Chesapeake & Delaware Canal, was selected and surveyed as the most available. A plan has been prepared for a canal 25 feet deep and with a bottom width of 125 feet, and such a canal along this route and with these dimensions is recommended. The estimated cost of construction is $9,910,210.

The board is of opinion that the Chesapeake & Delaware Canal property should be acquired by the United States by purchase. The cost has heretofore been estimated at $2,514,290. (See S. Doc. No. 215, 59th Cong., 2d sess.) No definite proposition has been received by this board for the sale of the canal. The purchase price is in addition to the construction cost stated above.

The importance of this section is deemed sufficient to warrant the immediate purchase of the existing canal and the inception of work for its enlargement as soon as funds can be made available.

Norfolk-Beaufort Inlet section.—All practicable routes have been examined and a route via the Albemarle & Chesapeake Canal, Currituck Sound, Alligator River, Rose Bay, and Adams Creek has been selected and surveyed as the most available. A plan has been prepared for a canal having a depth of 12 feet and a minimum bottom width of 90 feet and such a canal along this route is recommended. The estimated cost of construction is $4,901,580. This canal can be deepened subsequently if the commerce developed warrants such enlargement.

The property of the Albemarle & Chesapeake Canal Co. is recommended to be purchased by the United States, the estimated cost of acquiring the same being $500,000, which is in addition to the construction cost stated above.

It is believed that the commercial necessities in this section as well as the comparatively low cost of the canal warrant the immediate purchase of the Albemarle & Chesapeake Canal, and the inception of work on the enlargement and extension recommended, without delay.

GENERAL REMARKS ON FREIGHT TRANSPORTATION.

The general question of the advantages to be gained by opening through water routes for the carriage of freight have been discussed in numerous reports and papers during the past few years. It is unnecessary for this board to go deeply into this subject in this report; but it may be well to touch on certain aspects.

It is claimed that large outlays for the improvement and construction of internal waterways are uneconomical in that the service of freight carriage can be performed better and with greater economy along the coast by ocean-going lines (including steam and sail cargo vessels and ocean-going barges under tow) and internally by the railways. In support of this are cited the great development of the coastwise and Great Lakes traffic and of the railway systems and the

decline in many instances of water-borne commerce of the rivers after parallel lines of railways have been established. It would appear to the board that such reasoning is only partly justified in fact.

As shown in the report of the Philadelphia committee on traffic, the annual losses of life and property in the coastwise trade of the United States are appalling and are apparently unavoidable. To minimize these losses the vessels used must be strongly built and of an expensive type. The relative cost of the type of carrier per ton is approximately as follows: [1]

Ocean vessels	$75. 00
Lake vessels	41. 50
Mississippi River tug with barges for 10,000 tons of freight	12. 00

To offset the losses marine insurance is taken out, which for an outside route runs from 8 to 12 per cent annually,[2] as against an average of 4 per cent for an inside route.[2]

Both of these factors make toward an increase of cost of carriage.

Another increment of cost for an outside route lies in the greater time consumed, due to a longer course generally necessarily followed, and to delays incident to fog and storm.

From figures presented the board believes that navigation by interior lines presents advantages to commerce over outside routes which vary in value for different sections, but which are sufficient in general to justify the opening of certain interior lines.

The decline of internal waterway traffic in many localities which has followed the construction of railway lines the board believes to be due to causes other than the inherent advantages of railway freight traffic, and which are to a certain extent artificial.

Water-borne commerce is necessarily confined to the limits of navigation, and rehandling is necessary when points beyond such limits are to be reached, while cars can be transferred from line to line and point to point without breaking bulk. This advantage will always remain with the railway carriage. In sparsely settled areas sufficient commerce may not exist within easy haul of the waterways and there the railway lines may be the more advantageous. The history of our waterways shows that originally they were frequently the only possible channels of commerce and bore all the traffic of the regions traversed. Later came the railway, and the water commerce declined. Still later, with an increase of population, came commerce sufficient in amount to supply both rail and water channels of communication, and the water commerce increased.

The decline of the volume of water-borne commerce in competition with the railways is partly due to other causes which should be mentioned. In the past, railway development in the United States has been in advance of the actual necessities of commerce. Under these circumstances, in their fight for existence, the railways have been permitted to make discriminating rates by which points at which water competition was possible are served more cheaply by rail than are points not so favored. Since under the competition of the several railways with each other rates had to be kept at a minimum con-

[1] Report of Special Board of Engineers on Survey of Mississippi River, 1909, p. 24 (H. Doc. No. 50, 61st Cong., 1st sess).
[2] Philadelphia Report, p. 200.

sistent with covering the costs of operation and maintenance and paying a return on moneys invested, it is evident that lower rates granted to points with water competition have to be compensated for by the higher rates to the interior points, or, in other words, the interior population has had to pay in part for the freight service to the population on the waterways. This is a manifest injustice which will undoubtedly be corrected when the modern tendency to cause charges for public utilities to be made in accordance with the cost of the service rendered has received further development. Instances are of record where a waterway carries little or no commerce, but where its presence causes a lower railway freight rate within the area of its zone of influence. The condition is wholly artificial and must disappear in measure as the inflexible necessities of world competition shall force production and trade into the area and lines of least cost.

Similarly, it has been a policy of the railway companies to obtain possession as far as possible of all available wharf space in terminal cities, partly with a view to preventing competition. The recent movement toward providing adequate public wharf space in the cities will counteract this evil. Further, in many cases, railways have been so operated as to throw obstacles in the way of dividing a long-distance carriage between rail and water and thus to make an all-rail carriage most advantageous. This has been done by increasing the difficulties and costs of transfer between the rail and water carriers, by refusing to make or honor through bills of lading over mixed rail and water routes, or by making charges for short hauls by rail for distribution from water terminals prohibitively high. Since the railways are quasi-public institutions, owing their possibility of existence to important public rights granted by law, it is certain that a policy of this kind which is manifestly contrary to the public interests must eventually be changed. Until action has been taken by the Nation and States which will insure cooperation between transportation companies operating by rail and by water and thus provide for the interchange of commerce at the minimum of expense to the public, the full benefits to be obtained from the improvement of waterways can not be had, and the benefits received must be measured mainly by the lowering of rail freight rates to favored communities located on water routes.

Railways are a necessity and have natural advantages sufficient to justify their continued existence and extension. It is a mistake to assume that the opening of additional channels for commerce by improving the waterways will necessarily be disadvantageous to the railways. Each channel of commerce has its own legitimate field of operations—and the increase of the facilities for intercommunication, where wisely made, is invariably followed by increased prosperity for all. From a recent report [1] it is found that in Germany, where development of waterways has been the policy of recent years, in 1875 the traffic over 26,500 kilometers of railways amounted to 10,900,000,000 kilometer tons; and that over 10,000 kilometers of waterways amounted to 2,900,000,000 kilometer tons; in 1905 the traffic over 54,400 kilometers of railways was 44,600,000,000 kilometer tons; and that over the 10,000 kilometers of waterways was 15,000,000,000 kilometer tons. Here was an increase of railway mileage of 105 per cent. The

[1] Civil Engineering at the Universal Exposition of Brussels 1910—Public Works in Germany—Publication of Permanent International Association of Navigation Congresses.

kilometer and mile tonnage increase by rail was four times; that by water five times.

Again, it is of record that the city of Liverpool opposed the construction of the Manchester Ship Canal, which connects Manchester with the sea through the port of Liverpool, in the fear that there would be a resulting diminution of the commerce of Liverpool in favor of that of Manchester. It is now also of record that this fear has been groundless and that the opening of this canal has been followed by an increased growth of Liverpool commerce.[1]

GENERAL REMARKS ON THE MILITARY VALUE OF THE PROPOSED WATERWAY.

It is a well-established principle that, for the defense of a frontier threatened by an attack from without, at some unknown point, the forces for the defense shall be concentrated within the frontier line at points from which they can be moved rapidly and safely to the actual point of attack when developed. The proposed intracoastal waterway between New York and Norfolk forms a most desirable line for such movement of troops, lying, as it does, for its entire distance under the shelter of fortifications built or planned for the defense of the coast. The section between Narragansett Bay and Long Island Sound is less well suited for this purpose, inasmuch as it skirts the coast closely between the defenses at the eastern entrance of Long Island Sound and those of Narragansett Bay, where it can be approached closely by a hostile fleet. While the section from Norfolk to Beaufort Inlet also, for a portion of its way through Currituck Sound, lies within distinct view of the ocean, the shoal waters of the ocean to the north of Cape Hatteras would make it extremely dangerous for a hostile fleet to approach the coast within effective range of gun fire, and therefore this section would also be of great value for military operations. The usefulness of such portions of this inland waterway as were in existence at the outbreak of the Civil War was thoroughly proved in the operations at that time.

The dimensions recommended for the waterway between New York and Norfolk are sufficient to permit navigation by any of the steamers of the United States coastwise passenger trade and by the largest class of inland waterway boats. From Norfolk to Beaufort Inlet the depth recommended is sufficient for navigation by most of the inland waterway passenger steamers.

For the movement of troops, sheltered water transportation affords many advantages over transportation by rail. Among these advantages may be named (*a*) the possibility of keeping the larger administrative units united in a single carrier; (*b*) the diminished chances of delay to an entire expeditionary force by the wreck of one of the transporting units; (*c*) the smaller number of transporting units required; (*d*) the greater freedom from ordinary delays in transit due to ordinary commercial traffic.

The number of transportation units required for a division of troops by rail and by water with field equipment, rations and forage for three

[1] P. 228, Report of Barge Canal Terminal Commission, New York, 1911.

days, obtained through the courtesy of Lieut. Col. R. McA. Schofield, Quartermaster's Department, is as follows:

If rail transportation is used the following would be required:

For enlisted men, 356 passenger cars.
For officers, 26 passenger cars.
For civilian teamsters, etc., 13 passenger cars.
Baggage, etc., 78 baggage or freight cars.
Horses and mules, 344 stock, if large-size cars; if small, 420.
Wagons, guns, etc., 141 flat and freight; wagons to be loaded with ammunition, rations, etc.
Total, 958.

To move a division of troops by water there would be required:

Twelve ships, size of *Kentuckian* (A. H. Co.), 20-foot draft, or 11 ships, size of *Texan* (A. H. Co.), 20-foot draft, or 22 ships, size of *Momus* (S. P. Co.), 16-foot draft.

The above is based on a complete division, viz, 9 regiments of Infantry, 1 regiment of Cavalry, 2 regiments of Artillery, 1 battalion of Engineers, 2 companies of Signal Corps, 4 Hospital Corps companies, wagon and pack trains, and consisting of the following: 780 officers, 12 veterinarians, 565 civilians, 18,533 enlisted men, 8,265 horses and mules, necessary wagons, ambulances, guns, caissons, carts, etc.

One hundred and forty-two thousand one hundred and seventy-two gross tonnage of space is required to accommodate the above.

One tug and three excursion barges drawing 9 feet loaded can carry one complete regiment and its impedimenta.

For naval purposes it is necessary here only to invite attention to the very great advantage to be obtained by providing an additional and protected entrance for each of the ports from New York to Norfolk, inclusive—an advantage which would make impossible an effective blockade of any one of these ports.

From the above it is evident that the construction of the canal would add greatly to the defensive strength of the United States.

GENERAL REMARKS.

With these considerations in mind, the board has arrived at the conclusions given above, based on the detailed information contained in the reports for each section.

In laying out the proposed canal routes the board has avoided grade crossings with trunk lines of railway. Where railway and highway lines have to be crossed, such an arrangement is proposed as will cause a practicable minimum of interference between the land and water traffic, bringing to a single bridge highways which are close together and making all bridges of the bascule type, with a clear width of opening of 150 feet and with a maximum practicable clear height beneath when closed.

To reduce the difficulties of navigation, the canal lines are laid down in tangents connected by curves having a radius of 2,000 feet as a minimum, when practicable, with a widening of cross section at the curves proportional to the increased width of waterway occupied by vessels while turning.

In the detailed reports for each section of the waterway will be found the reasons which lead the board to recommend for each section the adopted route and the adopted cross section as well as the

economic considerations which justify to the board its recommendation as to the advisability of an immediate or a future construction of the canal.

Beginning in the lumber region of North Carolina the first section is found to be the cheapest, the draft required to carry commerce existing and probable in the immediate future is the least, and it can be made available for commerce quicker than any other, practically following in fact a route in use at the present time. Freedom from tolls alone will be an aid to commerce. The section between Chesapeake Bay and Delaware Bay is likewise now in use, and its betterment is comparatively inexpensive. There can therefore be no question as to the position of the board on these two southern sections. The section between Philadelphia and New York is entirely new, extremely costly, and involves the use of a large and efficient plant similar to that in use on the Panama Canal, soon to be available for other United States work. As shown elsewhere in this report, the board has been convinced that in spite of cost and difficulty the New Jersey section should be undertaken. For the Rhode Island section there is available a succession of lagoons and low-lying marshes which make the canal to all intents and purposes a question of dredging, which can be done rapidly or slowly without great difference in ultimate cost, so that economy of construction in that link is not a question of an enormously expensive plant.

Boston-Narragansett Bay section.—The law requires a "survey for the construction of a continuous waterway, inland where practicable, from Boston, Mass., to Long Island Sound * * *," of which the portion lying immediately south of Boston Harbor was assigned by the Chief of Engineers, in accordance with the recommendation of the board, to the officer in charge of the district of Boston. The words "inland where practicable" make it necessary to study not only a strictly inland connection between Narragansett Bay and Boston Harbor, but also to cover the case of a possible inland canal terminating in Plymouth Harbor, only 30 miles south of Boston Harbor entrance, as well as the Cape Cod Canal between Barnstable Bay and Buzzards Bay, now under construction by a private corporation on plans approved by the State of Massachusetts.

The importance of providing a safe and uninterrupted water route for the traffic annually passing around Cape Cod from the South Atlantic coast of the United States and from Long Island Sound early led to surveys and projects for the creation of an artificial waterway across the peninsula of Cape Cod, and also for a more completely inland route from Boston Harbor to Narragansett Bay. The following is a brief list of important and valuable reports on the subject:

BIBLIOGRAPHY.

(*a*) Report on a route from Buzzards Bay to Barnstable Bay by Mr. Thomas Machin, in 1776. Collections of Massachusetts Historical Society, Volume VIII, printed in 1826. Massachusetts State Library.

(*b*) Plan of survey by Mr. John Hills, under resolve of the General Court of Massachusetts in 1791, filed in archives of State of Massachusetts. See also monthly bulletin of the Boston Public Library for January, 1910.

(*c*) Manuscript map bearing title "A survey for a water communication from Weymouth landing places in Boston Harbor to the tidewater at Taunton Great River leading to Narragansett Bay in Long Island Sound, by order of the honorable legislature agreeable to their resolve dated March 6, 1806. Boston, February 1, 1808, by Benj. F.

Baldwin." Filed as catalogue No. 1720, Massachusetts archives, collection of maps and plans.

(*d*) Manuscript report of a committee composed of William Taylor and Eliphalet Loud, dated Boston, Mass., February 1, 1808, filed in Massachusetts State Archives as Chapter 120–B, Resolves of 1807, February 28, 1808.

(*e*) Pamphlet on a canal from Worcester to Providence, published by the committee of the county of Worcester, December, 1822.

(*f*) Report of the joint special committee of the Legislature of Massachusetts, printed by joint order of March 28 and 29, 1860, public document No. 34. This contains an engraved map of the survey for a Cape Cod canal made in the season of 1824 by Maj. P. H. Perrault, United States Topographical Engineers, and his report dated February 25, 1825; also a report of Gen. Barnard, member of the board of internal improvements, dated November 13, 1829, assisted by Maj. William T. Poussin, Topographical Engineers, assistant to the board; also a report of Col. J. J. Abert.

(*g*) Report of joint committee of 1860 of the Legislature of Massachusetts, printed in 1864 as public document No. 41. This gives a thorough history to its date and the results of very complete surveys and investigations made in 1860 and 1861, but does not contain the maps and reports printed in 1860 in public document No. 34, above. It also discusses dangers of excessive currents through an open sea-level cut, and suggests the idea of overcoming the excessive slope by debouching at Plymouth, but does not recommend the method, in view of the cost as compared with the cost of locks to serve the same purpose. (See p. 55 of the document.) It mentions also surveys for canals from Boston Harbor to Narragansett Bay via the following routes: One beginning at Weymouth Back River, which divides Weymouth from Hingham, and passing through Weymouth, a corner of Hingham, Abington, East Bridgewater to Fitaquit Bridge in Middleboro, thence through Middleboro and Taunton to Assonet Bay, on Taunton Great River, about 8 miles below Taunton village. The summit level on this route was in Abington. The other, being the westerly route, began at Weymouth Fore River and passed through the towns of Braintree, Randolph, North Bridgewater, West Bridgewater, Bridgewater, and Raynham to Taunton Great River in Taunton, the summit level being at Howard's meadow, in Randolph.

(*h*) Report of Gen. J. G. Foster, lieutenant colonel, Corps of Engineers, United States Army, dated May 10, 1870, in Annual Report of the Chief of Engineers for 1870, pages 477–495. This gives a brief history of former operations, taken from Document No. 41, above, and appends a copy of the report of the board of internal improvements, made in February, 1825, before Maj. Perrault's report of surveys. This does not appear in any of the previous papers. Gen. Foster discusses the Cape Cod Canal at length, with estimates of cost, etc.

(*i*) Pamphlet by Clemens Herschel, chief engineer Cape Cod Canal Co., in 1878. Press of Rockwell & Churchill, 1878.

(*j*) Hearing before the joint committee on harbors and public lands upon the petition of H. M. Whitney and others for an act of incorporation for the Cape Cod Canal Co., March 6, 1880.

(*k*) Report of Lieut. Col. G. K. Warren, Corps of Engineers, United States Army, dated February 3, 1882, in Annual Report of the Chief of Engineers for 1882, pages 579–595, which, however, is closely limited to the question of approaches to the Cape Cod Canal, as the latter was proposed at that date by the Cape Cod Canal Co., of which Mr. H. M. Whitney was president.

(*l*) Short report of Col. S. M. Mansfield, contained in Annual Report of the Chief of Engineers for 1897, pages 64 and 864, on the approaches to the Cape Cod Canal. He stated that there was no Cape Cod Canal, and as the company that was to build one had forfeited its charter by failing to comply with its provisions, no approaches were needed.

(*m*) Report on ship canal from Taunton River to Boston Harbor by the board of harbor and land commissioners, under resolves of 1901, chapter 104, and of 1902, chapter 82. The estimated cost was over $57,600,000, and 14 locks were contemplated. The summit level was at elevation 130 above mean low water in Boston Harbor. The unit prices for earth excavation varied from 20 cents to 35 cents, averaging 29+ cents per cubic yard, according to the nature of the soil, those for rock depending on the kind of rock and its location, from $1 to $10, averaging $1.37 per cubic yard. To these figures 15 per cent was to be added for contingencies. A depth of 25 feet was proposed, with a bottom width of 130 feet and side slopes of 1 on 2 in earth and vertical sides in rock cuts.

(*n*) A paper by Mr. William Barclay Parsons, chief engineer of Cape Cod Canal (under the most recent charter), read before the Atlantic Deeper Waterways Conference, Philadelphia, Pa., November 19, 1907, printed in the Annals of the American Academy

of Political and Social Science, January, 1908, page 81. Thismmus arizes some of the above historical data; states that while the law requires a width of only 100 feet, "it is probable that the minimum width will be greatly exceeded; in fact, it is most likely that the passing places, instead of being made three in number, will be connected so that the canal will have everywhere a bottom width of 150 to 200 feet." The depth is stated to be 25 feet at mean-low water, giving a depth through the 8 miles of canal of 30 feet at mean-high water in Buzzards Bay. There is to be no lock, the engineers of the canal company believing that tidal currents will not exceed practicable velocities. Mr. Parsons puts the estimated tonnage in 1897 of materials that could have used a canal, had there been one available, at about 18,000,000.

(*o*) Report of board of harbor and land commissioners, State of Massachusetts, for year 1909, public document No. 11. Commencement of work on Cape Cod Canal was reported to the joint board by the canal company June 21, 1909; on November 30, 1909, 46,000 tons of stone had been placed in the breakwater and 230,000 cubic yards of excavation had been done in Barnstable and Buzzards Bays; the question of railroad crossings had been decided on June 3, 1907; the canal would probably be completed before June 3, 1912; failure to complete would render the act chartering the company null and void; recommendation was therefore made that extension of the five-year period for completion be made discretionary with the joint board. (Board of railroad commissioners and board of harbor and land commissioners.)

(*p*) Report of Board of Harbor and Land Commissioners, State of Massachusetts, for year 1910, public document No. 11. The joint board on September 9 and 23, 1910, passed orders certifying and approving the issue by the canal company of stock and bonds aggregating 8,190 shares of stock and $820,000 in bonds, making authorization to December 1, 1910, of a total of 14,180 shares of stock of the par value of $100 each and $1,420,000 in bonds. On December 1, 1910, approximately 45 per cent of the breakwater construction had been completed and work suspended for the winter, and approximately 25 per cent of the total work on the canal had been completed.

(*q*) Report of the Commission on Inland Waterways on a Free Ship Canal connecting Boston and Narragansett Bay, according to chapter 26, Resolves of 1911, dated May 1, 1911. The commission was to consider in what manner the Commonwealth may best cooperate with the Federal Government in the construction of a free ship canal across the State. The commission was of opinion that cooperation with the Federal Government could only take effect by sharing in some manner the cost of the construction, and in the supplying by the State of such facilities in the way of terminals, both at the ends of the canal and at intermediate points, as would make the canal useful and convenient for the shipment and receipt of freight. The right of way in Massachusetts comprises about 9,000 acres of land, which with land damages and damages to water privileges would cost $900,000, to which $1,000,000 should be added for terminals, making a total outlay on the part of the Commonwealth of $1,900,000. This report contains a digest of letters and hearing, and the conclusions of the commission are that the facts as they now appear do not warrant the commission in advocating the present construction of the proposed canal. (See Appendix A.)

As actual excavation by a private company was in progress on the Cape Cod Canal, and all topography and levels were thus available without Government surveys, field work was limited to the inland routes between Taunton and Boston Harbor. A route via Brockton had been surveyed by the State of Massachusetts in 1901. (See Bibliography under heading (*m*). That survey showed that such high ground existed near Brockton as to necessitate an impracticable number of locks, and that the summit level would have to be supplied by pumping salt water for a long distance. For these reasons no field work was done on that route by this board. For comparison purposes the route is shown, however, on the accompanying map.

Counting the Brockton route and the Buzzards Bay-Barnstable Bay-Cape Cod route, both of which, although unsurveyed by the board, have been given careful study, seven different possible canal lines have received consideration, four of them having been actually surveyed and a survey of a part of a fifth having been made. Of the five surveyed, approximate computations of quantities showed that two were plainly superior to all the others; one terminating in Hingham Bay in Boston Harbor proper; the other in Plymouth Harbor,

on Massachusetts Bay, about 30 miles south of Boston Harbor main entrance. For both sufficient details were obtained to afford a reliable basis for definite quantitative estimates and for satisfactory solution of the problem of crossings for existing streams, highways, and electric and steam railroads. The law approved March 3, 1909, required the examination of "all practicable routes," and the seven routes shown on the map fully cover this requirement. Large numbers of minor variants were partly surveyed, field work on such variants being suspended as required by the above law as soon as the data obtained in the field showed that such a "proposed improvement is clearly inadvisable."

That requirement of law implies that surveys should be prosecuted until the inadvisability of the improvement is "clearly" shown. To determine this question properly, it was found necessary to continue field work on two routes, those via Hingham and via Plymouth, till costs were determined with sufficient accuracy to permit a true comparison to be made between the inherent commercial value of each route and its cost and between the two routes, considering both cost and commercial utility. The law also requires "a report upon the desirability of utilizing * * * any existing public or private canal * * * and the probable cost of acquiring the same."

All the factors involved are large. Water-borne commerce between Boston and the South to the amount of about 25,000,000 tons now passes outside of Cape Cod through waters so exposed as to prohibit the use of any but sea-going vessels. Rocky ledges and shoals and frequent fogs add to the other dangers to which this large tonnage is exposed. Wrecks and losses of life and property are frequent. Insurance is high, and freight rates are correspondingly affected.

No straight inland route is practicable. Starting from Point Judith, the North River Valley route, 96 miles long, is so crooked as to be only 20 miles shorter than the proposed Cape Cod Canal route, 116 miles long. The slow speed necessarily incident to a contracted waterway would in good weather make the time of passage through any canal via North River Valley exceed that via the Cape Cod Canal in spite of the saving of 20 miles in absolute distance. The Plymouth route, 113 miles long, computed from Point Judith, is only 3 miles shorter than that via the Cape Cod Canal, and passes at its northern end through 30 miles of the exposed deep waters of Massachusetts Bay, with a rocky coast line to the leeward in case of easterly winds. Commerce is likely to be interrupted by such winds as well as by frequent fogs.

The following physical characteristics are common to the North River Valley and the Plymouth routes. There would be few curves, none in either route of less than 2,200 feet radius. For purposes of estimate the minimum bottom width was taken at 125 feet, widened at all curves, and the clear depth at 18 feet; the submerged side slopes are one rise to two base, protected against wash. The locks were assumed 80 feet wide in the clear and 500 feet long in the clear, capable of taking at one lockage three barges and one large tug. The capacity of such a canal would be quite limited, and estimates for the same depth, but width of 200 feet on the bottom, have been prepared. A considerable proportion of the sea-going coal barges now running to Boston from the South draw too much water for the depth

of 18 feet. Estimates have therefore been prepared for a 25-foot depth on both routes, with both 125 and 200 feet bottom widths.

On the Taunton-Hingham line the first lock is about half a mile south of Weir village, and has a lift of 20 feet at low tide. The second is in the town of Halifax, about half a mile northeast of the confluence of the Taunton and Wenatuxet Rivers. Its lift is 15 feet, and attains the summit level. The third and fourth locks descend to tide level, and are in the town of Hingham, near the Nantasket Junction station of the New York, New Haven & Hartford Railroad. They are in flight, with lifts of 17.5 feet each at mean low water. The summit level extends from the second to the third lock, a length of about 26 miles, of which about 6 miles is through a lake formed by damming the North River just west of Union Bridge. About half of the supply of the summit level would have to be provided by pumping salt water from the North River below the dam, so that under ordinary conditions the water in the canal would be brackish.

On the Plymouth route with a 20-foot summit level the first lock is identical with the first lock on the Taunton-Hingham line; the second lock is just east of Holmes Hill in the town of Kingston, with a lift of 20 feet at mean low water. The summit level is about 26 miles long, and would be supplied partly by natural drainage and partly by pumping salt water from the Jones River. There would be no lake navigation in this summit level. On the Plymouth route a sea-level cut is possible, and estimates for both 125 and 200 feet bottom widths have been prepared. The first tide lock is about half a mile north of Dighton and has a lift of about 4 feet at mean low water. The second tide lock occupies the site east of Holmes Hill in the town of Kingston, described above, and has a lift of about 10 feet at mean low water. The natural fresh-water drainage and the difference in times of tide at the two ends is sufficient to fill the summit level without recourse to pumping until the traffic becomes very heavy. The sea-level route has thus in reality a summit level of 10 feet above mean low water, and the canal would be filled with fresh water for most of the year.

To secure all available data, a circular letter was widely distributed asking State, county, and municipal authorities, and commercial bodies and vessel owners, for their views as to the dimensions of canal needed to provide suitable facilities for commerce. This letter stated, for both the routes surveyed, the estimated costs of canals with bottom widths of 125 and 200 feet and depths of 18 and 25 feet. Almost without exception the 25-foot depth, the 200-foot bottom width, and the terminus at Hingham Bay were advocated by those replying to the circular, although this was the most costly route and type of canal, roughly estimated, without borings, to cost $40,047,000 for construction, and $836,000 annually for operation and maintenance. This high cost of operation is due to the fact that a large part of the supply of the summit level would have to be pumped from the ocean. In Boston there was little evidence of a serious desire for any canal, while great interest was evinced by persons living or doing business near the Taunton end. On receipt of the letter the governor of Massachusetts sent a message to the General Court of Massachusetts recommending the creation of a State commission to study the question, and such a commission was created by a resolve of February 28, 1911, "to consider in what manner the Commonwealth may best co-

operate with the Federal Government and certain other States in the development of inland waterways." On May 1, 1911, this commission submitted to the general court a report which is appended marked "A–1" (see p. 135). It sent out numerous circulars, held public hearings, and had many meetings. The final conclusion (see Bibliography, *q*) is that "the conditions of transportation may so change in the future as to make such a canal desirable and necessary, but the facts as they now appear do not warrant this commission in advocating the present construction of the proposed canal."

This authoritative expression of the view of the State of Massachusetts confirms the conclusions of the board itself that at the present time it is clearly inadvisable to construct a canal between Taunton and Boston on either of the inland routes.

This section of the intracoastal waterway is at the extreme northern end, and until the section next to it on the south is built the dangers of open-sea navigation around Point Judith have to be met by all craft passing through the canal. This would largely exclude the class of smooth-water coal barges, the use of which in place of the more costly ocean-going coal barges would cause most of the economies of transportation by canal. It is not to be expected that Congress will undertake the construction of all sections of the waterway at the same time, with provision for an economic rate of progress. The sections which form the connection between the manufacturing centers of the north and the coal, lumber, and truck producing regions of the south by a waterway which avoids the dangers of the Atlantic coast are those for which there is the most urgent necessity, and the construction of these sections in such order as will permit a most economical use of plant should be entered upon first. The full benefits to be derived from the New England sections of the waterway can be attained only after the more southern sections are open for navigation.

There are many good reasons for postponing work on the Massachusetts section, of which not the least is the desirability of learning to what extent commerce actually takes advantage of the facilities provided by the more southern and central sections, and whether the greater depth and width demanded for this Massachusetts canal by all parties interested is really justified by experience on these links. A stronger argument for delay is the probable early completion of the Cape Cod Canal by private parties. The best route inland from Point Judith via Taunton is practically the same length in miles as that via the Cape Cod Canal, and if both were available it is hard to foresee which route would be followed by the bulk of water-borne commerce. With the opening of the Cape Cod Canal, much will be learned. At present persons in positions to be well informed differ widely in their views. The board has been assured by such persons that few vessels of any type would use the Cape Cod Canal even if operated toll free; by others, that not even steamers would pass outside the cape, but that all vessels would use the Cape Cod Canal as soon as opened. That canal will have a depth of 25 feet and a bottom width of 100 feet. Experience will show whether the 200 feet so uniformly demanded for the Taunton canals by the navigation interests is necessary.

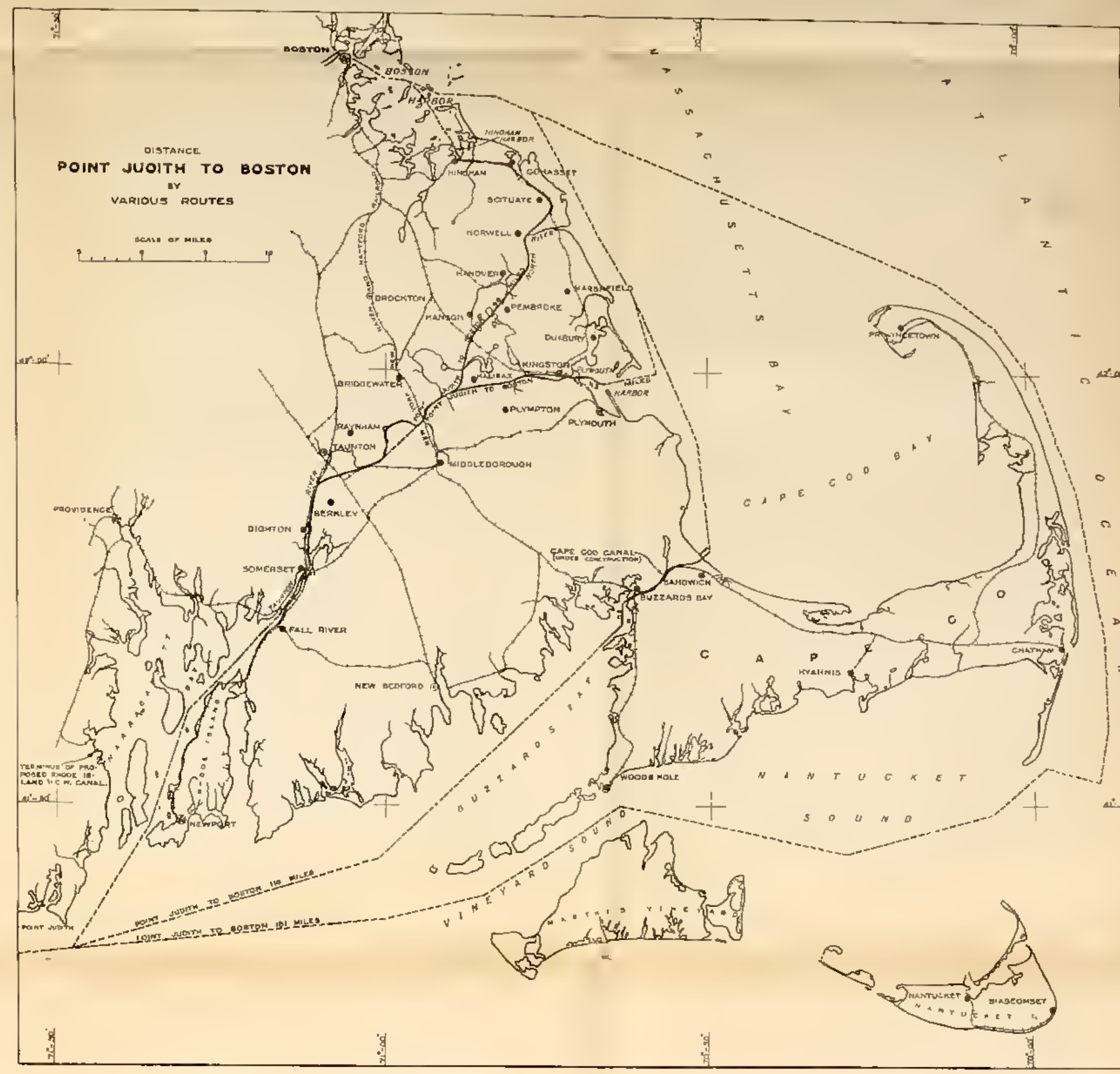
Taking all the above matters into consideration, the board believes that the improvement between Taunton and Boston is "clearly inadvisable" at the present time. The surveys have been suspened, but the maps so far as completed are submitted with this report. It will be noted that no borings have been made, but the character of excavation is quite well known from wells, railroad cuts, etc., near the line of the canal. Toward the southern end excavation would, with some exceptions, be easy. At the northern end cutting would be mostly in solid rock. While the estimates are less reliable than if based on thorough and numerous borings, they are believed to be sufficiently close to prove that either canal would be very costly.

There remain only the questions of utilizing the Cape Cod Canal (now partially constructed) and of the probable cost of acquiring the same.

Through the courtesy of Mr. William Barclay Parsons, chief engineer of the Cape Cod Canal Co., the board has been furnished with the latest information as to the present plans for that canal. They are essentially the same as the plans originally approved by the harbor and land commissioners of the State of Massachusetts under date of May 8, 1907, and provide for a canal with a length of about 7¾ miles through marsh and high land with approaches, dredged for a short distance in Cape Cod Bay under the lee of a stone jetty, and for about 3 miles in the upper and sheltered end of Buzzards Bay. In the Buzzards Bay approach there are two rather sharp changes of direction. The Cape Cod Bay approach is straight. In the land cut no bend has a less radius than about 7,500 feet. About one-quarter of the land cut is in tangent, the balance is made up of curves, the general trace being gently sinuous. The Cape Cod Bay approach has a bottom width of 300 feet; that in Buzzards Bay a bottom width of 200 feet. Most of the land cut has a bottom width of 100 feet; but this is widened to 300 feet for the first 3,000 feet next to Cape Cod Bay, to 200 feet for the next 4,000 feet, to 250 feet for distances of 800 feet each at two passing places near Bournedale and Bourne, respectively, and to 250 feet for the 1,500 feet next to Bourne Neck, where the canal enters Buzzards Bay proper. In the submerged approaches side slopes of 1 on 3 are adopted, with low-water depths of 26 feet. In the land cut the side slopes are 1 on 2 from the bottom at −25 up to about −8 feet, where there is a berm about 25 feet wide. Above this the slopes are 1 on 2, protected with riprap up to about 10 feet above mean high water.

There are at times differences of elevation of the water surface of Cape Cod Bay and Buzzards Bay amounting to several feet; but the engineers of the canal do not anticipate difficulty from the resulting currents, either to navigation or to the cut itself, and no tide locks are therefore provided in the existing plans of the Cape Cod Canal.

Whether the route from Point Judith to Boston via the Cape Cod Canal, including, as it does, about 90 miles of exposed water, can properly be called an intracoastal route is open to question. The 90 miles is composed of two sections, separated by the long, safe anchorage of Buzzards Bay. The southern section, about 60 miles long, passes for most of the way close to safe harbors of refuge, and the northern section has one harbor of refuge at Plymouth.



UNITED STATES INTRA-COASTAL WATERWAYS

BOSTON MASS.- BEAUFORT INLET N. C. DIVISION

BOSTON HARBOR - NARRAGANSETT BAY SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE BOSTON DISTRICT

35 FOOT LEVEL PROJECT

BETWEEN TAUNTON RIVER AND HINGHAM HARBOR

MASSACHUSETTS

INDEX MAP

FROM SURVEYS OF 1909-10

SCALE $\frac{1}{200,000}$

0 1 2 3 6 12 MILES

PREPARED UNDER THE DIRECTION OF

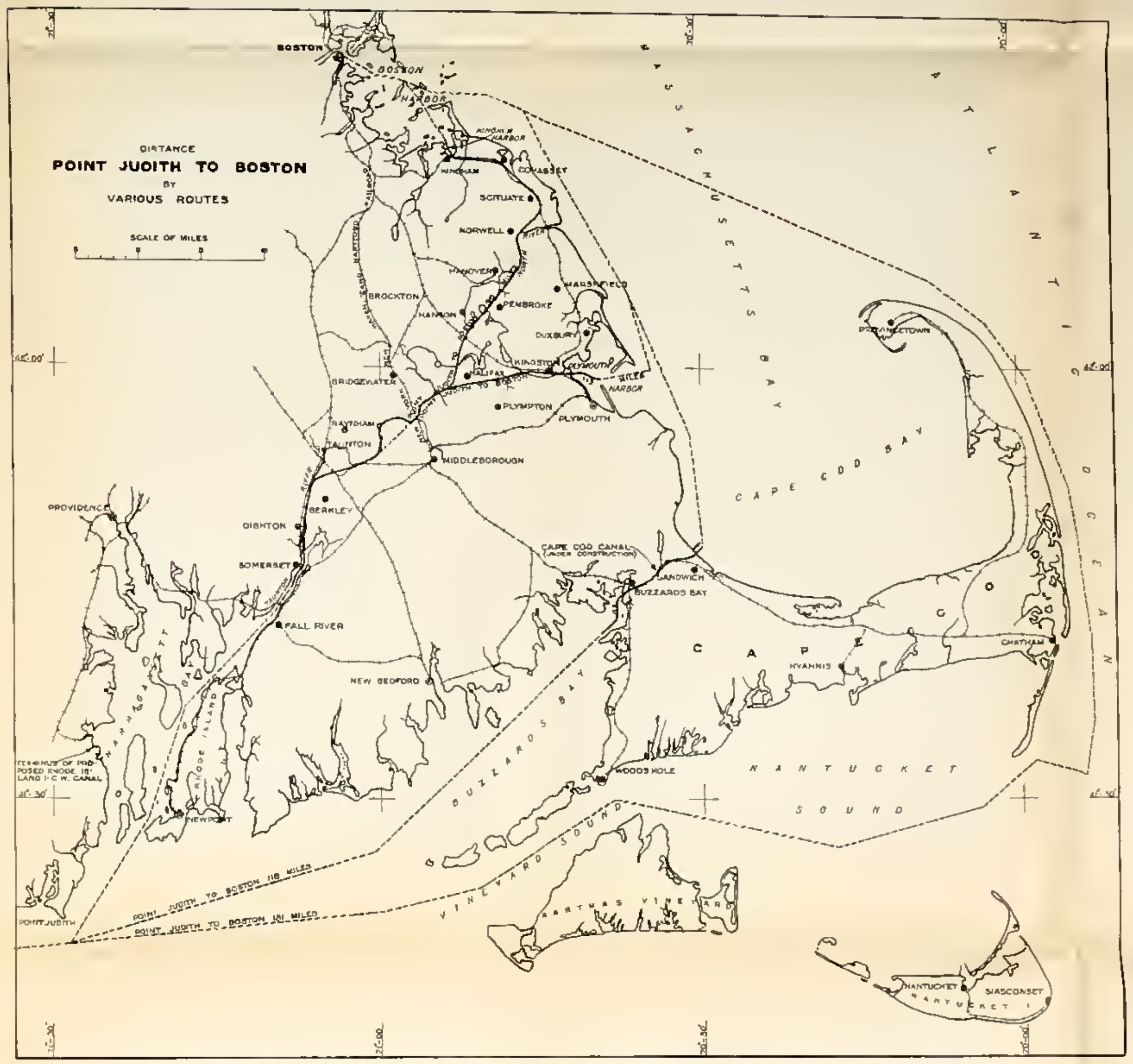
LIEUT. COL. EDW. BURR, CORPS OF ENGINEERS, U. S. ARMY MAY 1909 - MAY 1910

COL. F. V. ABBOT, CORPS OF ENGINEERS, U. S. ARMY SUBSEQUENT TO MAY 1910

BOSTON, MASS. SEPT. 11, 1911.

APPROVED

COLONEL CORPS OF ENGINEERS U. S. ARMY



UNITED STATES INTRA-COASTAL WATERWAYS

BOSTON MASS.- BEAUFORT INLET N. C. DIVISION

BOSTON HARBOR - NARRAGANSETT BAY SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE BOSTON DISTRICT

SEA LEVEL PROJECT

BETWEEN TAUNTON RIVER AND PLYMOUTH HARBOR

MASSACHUSETTS

INDEX MAP

FROM SURVEYS OF 1909-10

SCALE $\frac{1}{200{,}000}$

MILES

PREPARED UNDER THE DIRECTION OF

LIEUT COL. EDW BURR, CORPS OF ENGINEERS, U. S ARMY MAY 1909-MAY 1910

COL. F. V. ABBOT, CORPS OF ENGINEERS, U S ARMY SUBSEQUENT TO MAY 1910

BOSTON MASS SEPT 11, 1911

APPROVED

Frederic V. Abbot

COLONEL CORPS OF ENGINEERS U S ARMY

Even if the Cape Cod Canal route can be classed properly as "intracoastal," there still remains the question whether a partially completed sea-level cut on which work is in active progress can be considered by the board as "an existing public or private canal." To buy under such conditions seems contrary to public policy and to good business principles. Private citizens of the United States have in good faith taken up the question for themselves and have decided that they can invest certain sums in making a canal for commercial uses, looking to the tolls on anticipated commerce through their canal to pay the interest on their investment and eventually to repay the capital. In carrying out their project contracts have been let and liabilities have been incurred. A compulsory sale would involve litigation, claims, and delays in opening the waterway for navigation. If it were not for the prospect of the early opening of the Cape Cod Canal route to commerce, the board feels that public sentiment in Boston might be in favor of having the United States take up the construction of some canal to do away with the present dangers of the passage around Cape Cod. Steps that would delay the opening of the Cape Cod Canal should be avoided. When the canal is completed, and navigation through it is a fact, the question of the advisability of putting in a tide lock or of omitting it will also receive a definite and exact answer. Congress can then take up the matter, and under the power of eminent domain can acquire the completed canal at a price based upon known facts and proportioned to its utility as indicated by the amount of commerce paying tolls.

The board therefore reports that at the present time it is not advisable for the United States to construct an inland canal between Taunton and Boston nor to utilize the partly constructed Cape Cod Canal, and therefore it appears unnecessary for the board to report at this time on the probable cost of acquiring the Cape Cod Canal.

For convenience of reference the following table is appended, showing the cost of the several routes upon which surveys were made in sufficient detail to afford a basis for reliable estimates:

Estimated cost of various types and dimensions of canals between Narragansett Bay and Boston.

Description.	Depth of water.	
	18 feet.	25 feet.
Lock canal, 35-foot summit, bottom width 200 feet:		
Cost of construction, Taunton River to Hingham Harbor	$29,590,000	$40,047,000
Annual cost of maintenance	807,120	836,120
Lock canal, 35-foot summit, bottom width 125 feet:		
Cost of construction, Taunton River to Hingham Harbor	24,955,000	32,470,000
Annual cost of maintenance	807,120	836,120
Lock canal, 20-foot summit, bottom width 200 feet:		
Cost of construction, Taunton River to Plymouth Harbor	20,570,000	26,848,000
Annual cost of maintenance	561,400	591,400
Lock canal, 20-foot summit, bottom width 125 feet:		
Cost of construction, Taunton River to Plymouth Harbor	17,453,000	21,678,000
Annual cost of maintenance	561,400	591,400
Sea-level canal, bottom width 200 feet:		
Cost of construction, Taunton River to Plymouth Harbor	35,696,000	47,133,000
Annual cost of maintenance	441,400	473,400
Sea-level canal, bottom width 125 feet:		
Cost of construction, Taunton River to Plymouth Harbor	28,429,000	37,420,000
Annual cost of maintenance	441,400	473,400

NARRAGANSETT BAY—LONG ISLAND SOUND SECTION.

Between April 3 and 15, 1909, a preliminary line was marked out on the ground and a rough stadia survey was made of it for the purpose of obtaining an approximate profile for use of the board in its examination of the proposed route on April 28, 1909.

The board, after carefully going over the ground, directed that surveys be made and estimates prepared for a canal along the preliminary line selected, and also that alternative lines be examined and surveyed at a few places where more than one line appeared feasible. The board further directed "that in making these surveys and estimates, the depth of 18 feet with a minimum bottom width of 125 feet be considered as the basis and that the borings be made to give such additional data as may be conveniently practicable providing for subsequent deepening. It also directed that where the same can be done without any unreasonable additional expense, estimates on the same surveys be prepared for a canal with a depth of 25 feet."

SCOPE AND METHODS OF THE DETAIL SURVEYS.

In general the detail surveys covered a width of at least 1,000 feet along the proposed route, while in several places, such as through the ponds, the width was over 4,000 feet.

Field work for these surveys was begun June 23, 1909, and was completed December 31, 1909, except the borings, which were completed August 8, 1910. The force employed varied from one to five field parties, besides an assistant in charge, a draftsman, and one or two other men in the office. For the topography, stadia methods were used exclusively, based on a system of triangulation connected with the Coast Survey and on a line of spirit levels carefully run in duplicate over the entire route. In the hydrographic work, soundings were usually located by two transits on shore.

The datum plane used was mean low water at Newport, R. I., as established previously by several years of tidal observations.

A working map on a scale of 1 : 4,000 was first made, from which the final sheets on a scale of 1 : 10,000 were prepared by pantograph reduction.

From July to December, 1909, tidal observations were made in Narragansett Bay near Bissells Cove and in Little Narragansett Bay at Watch Hill, the two termini of the line, by self-recording gauges. The results of these observations are given in a table on each of the final maps and are sufficient to show that in the proposed canal, 31 miles in length and passing through several large ponds, no currents will be produced that would affect navigation materially. Estimates have been prepared for a canal of 18 feet depth with a minimum bottom width of 125 feet through the land portion and 250 feet width in the approaches and in the ponds traversed, and the figures in the text of this report refer to a canal of these dimensions. In addition, as directed by the board, estimates have also been made for a canal of 25 feet depth with a bottom width of 200 feet through the land portions and 300 feet width in the approaches and ponds.

DESCRIPTION OF ROUTE SELECTED.

The proposed canal extends from the west side of Narragansett Bay, about a mile below Wickford, to Fishers Island Sound, lying at

the eastern end of Long Island Sound, following in a general way a natural route parallel to the southern coast of Rhode Island, through valleys, tidal ponds, and across low divides within the towns of North Kingston, Narragansett, South Kingston, Charlestown, and Westerly. The total length of the line between waters of 18 feet depth at the two ends is 35.6 miles, of which 4.9 are approach channels, 19.4 are in tidal ponds and rivers, 2.3 are in salt marshes, and 9 are through lands above high tide reaching a maximum elevation of 50 feet.

Beginning at the eastern end of the route in the protected waters of the Western Passage of Narragansett Bay between Fox Island and the mainland, a channel of approach of about three-fourths of a mile in length is required to enter the canal proper at the shore of Bissells Cove, just below the village of Hamilton. From Beaver Tail Light, at the mouth of Narragansett Bay, to this point of beginning, a distance of 8 miles, the natural depth of water is over 30 feet; and a depth of 25 feet is available up the bay from this point to Providence and Fall River, distant 20 miles and 27 miles, respectively. A 21-foot depth to Fall River is also available by a route that is only 18 miles long.

Crossing Bissells Cove, a shallow body of water three-tenths of a mile wide at the mouth of the small Nannacatucket River, the line continues a mile farther in a southwesterly direction through a narrow ridge, reaching a maximum elevation of 50 feet, and follows a wooded swamp southerly past Carr Pond to tide water at the head of Pattaquamscott Pond, a distance of 2.5 miles in all. The elevation of this swamp varies from 20 to 13 feet. A very narrow gravel ridge having an elevation of 40 feet must be cut through just below Carr Pond.

Pattaquamscott Pond and River, through which the canal extends, lie in a deep valley about 1.5 miles west of Narragansett Bay, and are separated from the latter by a high ridge called Boston Neck. The pond is more than 60 feet deep in places and very little excavation will be required for a distance of 2 miles. Through the river below and across the "Cove," north of Narragansett Pier, for a distance of 4 miles, the water is shallow, but the bed is sand and can be easily excavated by hydraulic methods.

From the southwest end of the "Cove" the route across a ridge 1.4 miles wide, between Narragansett Pier and Wakefield, with a maximum elevation of 48 feet, passes just south of Silver Lake in Wakefield and enters the upper part of Point Judith Pond, a large body of tidal water, with an average depth of about 6 feet.

Continuing southwesterly two-thirds of a mile further across the upper arm of this pond and a narrow peninsula separating it from the main pond, the line swings southerly again and extends 2.5 miles down the main pond in water averaging nearly 6 feet in depth. At the foot of the pond and near the head of the breachway connecting it with the Harbor of Refuge at Point Judith, a sharp turn to the westward is made, and from thence the southerly shore of Rhode Island is nearly paralleled all the way to the western terminus of the canal.

Leaving Point Judith Pond, the line crosses a sand flat and marsh two-thirds of a mile wide, and continues for another two-thirds of a mile through the shallow waters of Potter Pond to the small but

growing summer village of Matoonoc. For 2 miles more the route is through flat open country, rising to a maximum elevation of 22 feet and sloping gently to the westward to Trustom Pond, a lagoon three-fourths of a mile long without permanent connection with the ocean and almost dry at low water. Near the middle of Trustom Pond the line deflects slightly to the south, in order to reduce as much as possible the work required on the half-mile cut through Green Hill. By so doing, the maximum elevation through the hill will be only 19 feet instead of the 35 feet that would be encountered upon a straight line.

West of Green Hill for a distance of 3 miles the route is through the low lands, marshes, and coves on the south side of Green Hill Pond and Charlestown Pond, and thence continues for 2.2 miles through the middle of Charlestown Pond, averaging 3 feet in depth, to Quonocontaug Neck. After crossing Quonocontaug Neck, two-thirds of a mile in width and reaching 18 feet elevation at its highest point, the middle of Quonocontaug Pond is traversed nearly its entire length of 2¼ miles in water averaging 9 feet in depth.

Beyond is Noyes Neck, or Weekapaug, a ridge nearly a mile wide with a maximum elevation of 45 feet on the line of the canal. The next stretch is through Brightman Pond, nearly 2¼ miles long and averaging 2.5 feet deep. Following this is the last cut through the land north of Watch Hill for a distance of 1¾ miles, with an elevation reaching 45 feet at one point.

The line proper ends at Colonel Willies Cove, in Little Narragansett Bay at the mouth of Pawcatuck River, whence a channel of approach 4.1 miles long to deep water in Fishers Island Sound, opposite Stonington, Conn., will be made, following the present 10-foot channel through Little Narragansett Bay.

ALTERNATIVE LINES SURVEYED.

At the eastern end of the proposed canal, where it enters the land on the southwest shore of Bissells Cove, an alternative location for the first mile of the route is feasible, following the west branch of the valley. This course, however, would be slightly longer, would require additional and sharper curvature with reverse curves, and would encounter about 125,000 cubic yards more ledge than the direct route, and therefore was rejected.

Across the ridge, between the cove and Point Judith Pond, a line through Silver Lake was considered. While a reduction of over 500,000 cubic yards of excavation in sand and gravel could be made by such a change, the lake with its water surface at elevation 20 would be practically destroyed, and the damages to the valuable estates surrounding it would probably more than offset the saving in excavation. Also an additional drawbridge would be required if highway accommodations were made equal to those by the route selected.

Between Trustom Pond and Green Hill Pond three routes were surveyed; one around the north of Green Hill through a wooded swamp, another straight across the hill halfway down its southern slope, and the third deflecting to the south and skirting the south end of the hill. Of these the last is the most favorable, as it requires the least excavation of both earth and rock, and introduces no sharp

curves. The northerly route has the greatest amount of excavation as well as the most curvature and greatest length.

Three routes were also considered and surveyed for crossing Quonocontaug Neck; one a short distance back from the beach, the second a mile from the beach, and the third about halfway between the other two. The third is the cheapest, requiring the least expense for excavation, and involving no excessive land damages. It was therefore adopted.

A choice of two lines through the land cut at Watch Hill necessitated surveys of both. One route crosses near the south shore in the midst of the summer residences, where land damages would be very high, while the other line lies a mile or more from the shore and north of the residential section, where land has not been subdivided and would therefore be comparatively inexpensive.

The saving of 595,000 cubic yards excavation in sand and gravel possible by the first route would not equal the saving in excessive property damage by the second. Also serious objections to the canal are certain to be made by summer cottage owners if it extends through their quiet settlement.

For the approach channel at the westerly end of the canal a route directly across Little Narragansett Bay and Napatree Point just north of Fort Mansfield was surveyed in addition to that selected following the present 10-foot channel north of Sandy Point. The direct route would be shorter and would avoid several angles in the channel, but the sand cut through Napatree Point would require jetties at one and perhaps at both ends in order to maintain it, so that the saving in excavation would be more than counterbalanced by the cost of jetty construction. Another point in favor of the route selected is the fact that it passes behind the Stonington outer breakwater, where a secure harbor is afforded for anchorages or for making up tows.

In addition to the above alternative lines the board directed that there be made "such surveys and estimates as may be necessary for making the entrance to the canal from Narragansett Bay, south of Boston Neck, near Narragansett Pier, in such a manner as to show the cost of the canal from Narragansett Bay at this point to the waters of Fishers Island Sound, without that portion of the line to the north of this entrance."

The results of these surveys and estimates show that the cost of the canal having its eastern terminus at Bissells Cove would be $12,322,000. The canal with its eastern entrance just north of Narragansett Pier will cost $11,399,000; but the exposed entrance, together with the reach of open water between it and the protected waters of Narragansett Bay would interfere seriously with the use of the canal in rough weather, when the benefits from it should be the greatest. Moreover, it is doubtful if a canal with only this entrance could be considered as coming properly within the requirements of the act of Congress which specifies a waterway "inland where practicable."

CHARACTER AND DISPOSITION OF EXCAVATED MATERIAL.

Commencing at the eastern end of the canal and going westward, the materials encountered and the proposed disposition of the excavated material may be described as follows:

At the outer end of the approach channel the material is mud and sand, which gradually changes to sand and gravel with a few bowlders

toward the shore and across Bissells Cove. This excavation, amounting to about 635,000 cubic yards, can be handled by clamshell and dipper dredges and deposited by scows in deep water east of Prudence Island or near Beaver Tail, in Narragansett Bay, requiring a tow of 6½ to 9½ miles.

The cut through the land between Bissells Cove and Pattaquamscott Pond is mostly sand and gravel (3,076 000 cubic yards) with about 331,000 cubic yards of rock below elevation 5.0 underlying the northerly half. It is proposed to use the greater part of the sand and gravel overlying the ledge to fill in a portion of Bissells Cove east of the canal line and to build out an area into Narragansett Bay around and south of Romes Point. The remainder of this material can be spoiled in low lands and hollows adjacent to the canal and in the deep water of the upper Pattaquamscott Pond. With the aid of pumps to keep the site free from water, it is probable that the ledge can be excavated in the dry, and at a much less cost than in the wet. Part of the rock will be needed at once for a wall around the area of new land, to be built near Romes Point, and the remainder will be available for slope protection either immediately or as soon as the canal banks have assumed their natural slopes.

Through Pattaquamscott Pond less than 450,000 cubic yards of excavation will be required, all being sand and gravel, which can be deposited in the deep water of the pond. In Pattaquamscott River below the pond and across the cove the 3,767,000 cubic yards of material is sand and fine gravel, capable of being handled by hydraulic methods and disposed of on the adjacent marshes.

Across the Wakefield divide 2,490,000 cubic yards of sand and gravel will have to be removed, about one-half with steam shovel and cars and one-half by hydraulic dredges. The only available dumping place for the cars is on the marshes toward the west end of the cove, where a large part of the dredged material can also be spoiled, the remainder going into Long Cove on the east side of Point Judith Pond.

In Point Judith Pond the 3,128,000 cubic yards of sand and gravel can be pumped into the coves on both sides of the line and upon the extensive marshes at the lower end of the pond. All the material in the sand flats and marshes beyond Point Judith Pond and in Potter Pond can be pumped upon the marshes on the south side of the canal, and these marshes will also hold all of the excavation through Matoonoc as far as Trustom Pond if it can not be otherwise disposed of.

The canal, however, from Matoonoc nearly to Charlestown Beach is located only about 500 feet on an average from the shore of the ocean, and the simplest method of disposing of the sand and gravel excavation would be by pumping it directly upon the beach, thus saving about 5 cents per yard on over 2,000,000 yards so handled.

If the material is not pumped out on the beach, that in Trustom Pond and that in the easterly half of Green Hill (except the ledge in the latter) may be deposited in the shallow waters of Trustom Pond north of the canal line, thus forming several acres of new land.

The ledge rock underlying Green Hill, which it is estimated will amount to 64,000 cubic yards, can be used at once for slope protection, or stored along the cut until it is needed for that purpose. The sand and gravel in the cut through the westerly half of Green Hill and through Green Hill Pond, amounting to over 1,000,000 cubic yards, can be spoiled in the coves and marshes north of the canal at the east end of the pond. Nothing but sand and gravel is indicated

throughout Charlestown Pond, all of which may be placed on the marshes and in shoal waters on the south side of the pond.

On Quonocontaug Neck a considerable quantity of ledge was found below elevation −5, overlaid with sand, gravel, and numerous bowlders. In some places the surface of the ground is literally covered with bowlders, large and small, so that the method of handling the work will differ from that in any other portion of the canal. All of the material overlying the ledge can be wasted upon the marshes south of the canal at the east end of Quonocontaug Pond. The ledge can be excavated in the dry by resorting to pumping to keep the cut free from water, and the rock can be stored along the banks if not needed immediately for slope-protection work.

Through Quonocontaug Point the material is similar to that across the neck, viz, sand, gravel, bowlders, and ledge. Some of the bowlders may require blasting, but most of them can be removed by dipper dredges. The material containing no bowlders can be pumped upon the marshes on the south side of the pond, while that containing bowlders can be removed by dipper dredges and deposited in deep holes prepared for it by hydraulic dredging outside of the line of the canal. The rock excavation being all below reference −10 could well be left until the canal was nearly completed and then used for slope protection at various places along the route.

Across Noyes Neck it is estimated that about 635,000 cubic yards of ledge rock will be encountered, in addition to nearly 1,000,000 cubic yards of sand and gravel containing a few bowlders. The latter can be removed by steam shovels and dredges and deposited on the marshes and flats at the east end of Brightman Pond, while the ledge rock which it is proposed to excavate in the dry can be stored until needed along the banks and in a cove at the northwest corner of Quonocontaug Pond.

In Brightman Pond the material is sand and gravel, amounting to 2,205,000 cubic yards, which can be removed by pumping and placed on the marshes on the south side of the pond.

The cut between Brightman Pond and Colonel Willies Cove is composed of sand and gravel with a few bowlders. A part of this excavation can be used to fill up several small ponds and low places to the south of the canal, a part can be deposited on the marshes on the south side of Brightman Pond, and a part on the marshes on the east side of Little Narragansett Bay south of Colonel Willies Cove.

The excavation in the approach from Colonel Willies Cove to Fishers Island Sound is mostly in sand and gravel. Some of this material may be pumped ashore on the marshes along the line, but the greater part of it will have to be dumped in deep water in Fishers Island Sound. A few bowlders will be found west of Pawcatuck Point and a larger number will be encountered east of this point and extending into Colonel Willies Cove. Off Pawcatuck Point a small area of ledge exists which will have to be broken up prior to removing by dredging.

BRIDGES AND FERRIES.

The proposed canal crosses 20 highways of more or less importance, 4 single-track electric railways and one single-track steam railroad. As all the bridges across canal must be drawbridges, it is important that the number be reduced to the minimum that will accommodate the travel. Accordingly, where the highways are near together, it is

proposed to provide one bridge to serve two or more and to build short stretches of connecting roads. All of the railroads except one electric line can be carried across on bridges used for highway purposes.

The style of bridge decided upon by the board is the bascule type, giving a clear opening of 150 feet. It is desirable that the clear height under the bridges when closed be as great as possible, or at least be sufficient to allow most of the smaller pleasure craft that will use the canal to pass beneath without opening the draw. This will not only avoid occasional delays for such boats but will also lessen the delays to travel over the bridges. All the bridges can be arranged so as to have a clear height of at least 16 feet above mean low water, and some of them will have considerably more than this height.

For several of the highways over which there is almost no travel except during the summer months the expensive construction and maintenance of a drawbridge appears unwarranted. Instead, it is believed that a small ferry, operated by cables and a gasoline engine, with one attendant, could be designed and built to fulfill all the requirements of travel at these roads for about one-eighth the cost of a bridge. The cost of such a ferry complete, with slips and their appurtenances, would not exceed $12,000. The success of this type of crossing could be tested by installing one during the early part of the construction work, and its defects could be remedied by the time others were required.

CROSSINGS.

The following table shows the railroad, trolley and highway, and highway bridges to be constructed over the canal, and the proposed railroad and highway changes along the route of the canal as further indicated on the detail map:

Crossing.	Type.	Bridge.	Present angle to normal.	Length of track or road relocation.	Clearance at mean low water.	Remarks.
			°	*Feet.*	*Feet.*	
Near south end of Bissells Cove.	Electric railroad.	Double-track draw.	30	3,300	21	Crossing to be moved 256 feet nearer Bissells Cove.
½ mile south	Highway	Draw	25	3,600	31	Road to be straightened and made normal to canal line.
Head of Pattaquamscott Pond.	Road	Ferry		4,000		Ferry to be located 350 feet north of present crossing.
Pattaquamscott River.	Highway	Draw	10 10	13,200	16	This bridge to replace Bridgetown bridge and Middle Bridge.
800 feet southwest of the cove.	Highway, railroad, and trolley.	do	23 54–30 60	1,600 2,600 3,600	31	Combined bridge to carry 3 roads across new waterway. Bridge makes angle of 35° 30′ with normal.
East of Silver Lake	Highway	do	30 50	3,400	36	Carries 2 highways over new waterway.
Matoonoc	do	Ferry		8,500		Matoonoc Road during year.
Moonstone Beach	do	do				West Road at Card Ponds summer only.
Charlestown Beach	do	do		200		
QuonocontaugNeck	do	do		5,200		Ferry replaces 2 roads.
Noyes Neck	do	do		6,400		Do.
Pleasant View	Highway and trolley.	Draw	10 0 0	10,600		2 highways and 1 trolley road.
Near Colonel Willies Cove.	do	do	10	1,700		Do.
Narrow River	do		8	1,700	20	1 highway and 1 electric line combined to replace 2 bridges—1 railroad pile trestle and 1 highway wood truss.

Total estimated cost, $1,258,000

WATER POWER.

No water sufficient for generating power for lighting any portion of the canal is available along or near the route.

The only water power that will be in any way interfered with by the construction of the canal is that at Hammonds Mill on the stream flowing from Carr Pond into the upper end of Pattaquamscott Pond. (See local map sheet No. 1.) This is a small grist mill operated intermittently, according to the demands of the farmers for several miles around who have long been accustomed to bring their grain there for grinding. When running, it uses about 30 cubic feet of water per second under a head of about 9.5 feet, thus developing about 33 gross horsepower. The drainage area tributary to this stream is about 7 square miles, which, upon the basis of 1.65 cubic feet per second per square mile as the average run-off available throughout the year, would make about 12.5 horsepower available continuously.

The canal will cut off this stream just east of the main body of Carr Pond, and destroy the power at the present site. It is proposed, however, to maintain the pond at its present elevation of about 13.5 feet by building a dam across the narrows which separate the main pond from the swamp through which the canal passes. If found desirable, a water power about equal to that destroyed could be developed at this dam, but the amount seems hardly sufficient to make it advisable.

It is planned to make the dam wide enough to carry the proposed road extending north along the west side of the canal from the proposed ferry below to the cart path in the woods to the west as described above. The estimated cost of the dam and the road is $10,000.

BREACH WAYS INTO THE PONDS.

Four of the ponds, Point Judith, Charlestown, Quonocontaug and Brightman, through which the canal passes are connected directly with the ocean by breach ways, all having a certain similarity and yet each differing from the others in physical characteristics.

The breach way into Point Judith Pond is the only one that has sufficient depth of water for boats larger than skiffs and that appears to be worthy of being maintained. Through this entrance about 7 feet at low water is now available into the lower end of the pond as far as the line of the canal. There is a considerable movement of sand in the breach way, caused partly by the unstable banks and partly by the littoral drift from the west. The littoral drift will be stopped when the westerly shore arm of the Point Judith Breakwater, now authorized, is constructed, and when the canal is built it is proposed to riprap the banks of the breach way to protect them from undermining, using stone that will be available from places along the route. What further treatment, if any, is required, can be best decided by a study of the conditions after the canal is completed.

The three other breach ways are useful chiefly for introducing and circulating in the ponds more or less salt water for the benefit of shellfish. As a supply of water much greater than that now existing will be furnished to the ponds by the canal, no improvement of these breach ways is at present contemplated.

The breach way into Charlestown Pond is nearly closed at its inner end, so that the ordinary rise and fall of the tide in the pond is only 0.1 foot. At Quonocontaug Pond the water is very shallow on the south side where the breach way enters, and less than 0.3 foot is the average tide.

In Brightman Pond a very narrow artificial channel exists, which provides a tide of about 4 inches in the pond.

TERMINALS.

At the eastern end of the canal (see Local Map Sheet No. 1) there is an excellent opportunity to make a small harbor and provide terminal facilities in Bissells Cove by dredging out the cove on both sides of the canal, and constructing wharves on the western and southern sides, thus forming a basin over 700 feet wide and about 3,000 feet long. The small stream called Nannacatucket River, which enters the cove from the west and now discharges into Narragansett Bay at the extreme eastern end of the cove through a channel 100 feet wide and 2 feet deep, is too insignificant to cause any strong currents in the new basin or in the canal entrance.

As the canal will form a new and greatly enlarged outlet for the waters of the cove, it is proposed to close the present outlet and to fill in a part of the cove east of the canal in order to provide greater wharf frontage.

The full development of the project would, in all probability, not be required for several years after the completion of the canal, and only a portion ($100,000) of the cost has been included in the canal estimate. This will provide for about half of the basin and wharf space in the western part of the cove, and the building of bulkheads on both sides of the entrance through the spit on the north side of the cove to make the passage easy for vessels.

In Colonel Willies Cove, at the western entrance of the canal, no terminal work is at present contemplated other than the widening of the approach and the construction of guiding bulkheads leading to the entrance. Sufficient land should be acquired around the cove for any wharf facilities that may be required in the future, but it is probable that the demand for such facilities will not be urgent for a considerable time. No anchorage ground or waiting place for vessels using the canal is needed at the cove, as ample accommodations of this nature exist behind the Stonington Breakwaters and in Stonington Harbor, at the western end of the approach channel.

The costs stated in the following summary estimates are based on thorough detailed studies of each locality in which character of soil, length of haul to dump, etc., were considered.

Summary of estimate for sea-level canal, Bissells Cove to Fishers Island Sound: Depth, 18 feet; bottom width, 125 feet in land cuts, and 250 feet in ponds and approaches; with an auxiliary entrance at the mouth of Narrow River 18 feet in depth and 100 feet bottom width, with protecting jetty extending to 20 feet depth of water at mean low tide in Narragansett Bay.

Excavation.

31,699,000 cubic yards sand, gravel, etc (average 129)	$4, 100, 350	
1,635,800 cubic yards ledge rock (average 2.52)	4, 277, 700	
Total, cubic yards, 33,334,800		$8, 378, 050
Slope protection, 308,000 cubic yards, at $2.50		770, 000
Bridges, ferries, and roads [1]		1, 258, 000
Land damages [2]		465, 000
Breakwater at mouth of Narrow River to 20 feet depth of water		108, 600
Miscellaneous items, including lighting, telephone line, etc		222, 200
		11, 201, 850
Engineering and contingencies, 10 per cent		1, 120, 150
Total		12, 322, 000

Summary of estimate for sea-level canal, Bissells Cove to Fishers Island Sound: Depth, 25 feet; bottom width, 200 feet in land cuts, and 300 feet in ponds and approaches, with an auxiliary entrance at the mouth of Narrow River 18 feet in depth and 100 feet bottom width, with a protecting jetty extending to 20 feet depth of water at mean low tide in Narragansett Bay.

Excavation.

55,354,000 cubic yards sand, gravel, etc. (average 13)	$7, 202, 750	
3,995,000 cubic yards ledge rock (average 3.11)	12, 426, 500	
Total 59,349,000 cubic yards		$19, 629, 250
Slope protection, 318,000 cubic yards, at $2.50		795, 000
Bridges, ferries, and roads [1]		1, 258, 000
Land damages [2]		465, 000
Breakwater at mouth of Narrow River to 20 feet depth of water		108, 600
Miscellaneous items, including lighting, telephone line, etc		232, 000
		22, 487, 850
Engineering and contingencies, 10 per cent		2, 248, 785
Total		24, 736, 635

Summary of estimate for sea-level canal, mouth of Narrow River (north of Narragansett Pier) to Fishers Island Sound. Depth, 18 feet; bottom width, 125 feet in land cuts and 250 feet in ponds and approaches, with a harbor sheltered by large breakwater at Narragansett Bay end.

Excavation.

25,524,690 cubic yards sand, gravel, etc. (average 132)	$3, 355, 869	
1,415, 868 cubic yards ledge rock (average 3.04)	4, 309, 545	
Total cubic yards 26,940,558		$7, 665, 414
Slope protection, 238,000 cubic yards, at $2.50		595, 000
Bridges, ferries, and roads [3]		930, 000
Land damages [2]		315, 000
Breakwater at mouth of Narrow River		485, 000
Basin in the Cove: 85 acres; with bulkheads (partial development)		272, 000
Miscellaneous items, including lighting, telephone line, etc		100, 500
		10, 362, 914
Engineering and contingencies, 10 per cent		1, 036, 291
Total		11, 399, 205

[1] If the State pays for road changes, this item will be reduced $125,000.
[2] If the State pays for land damages, this item will be eliminated.
[3] If the State pays for road changes, this item will be reduced $80,000.

Summary of estimate for sea-level canal, mouth of Narrow River (north of Narragansett Pier) to Fishers Island Sound: Depth, 25 feet; bottom width, 200 feet in land cuts, and 300 feet in ponds and approaches, with a harbor sheltered by a large breakwater at Narragansett Pier end.

Excavation.

44,333,000 cubic yards sand, gravel, etc. (average 131)	$5,781,290	
3,490,000 cubic yards ledge rock (average 3.23)	11,272,500	
Total, 47,823,000 cubic yards		$17,053,790
Slope protection, 248,000 cubic yards, at $2.50		620,000
Bridges, ferries, and roads [1]		930,000
Land damages [2]		315,000
Breakwater at mouth of Narrow River		485,000
Basin in the cove; 85 acres; with bulkheads; (partial development)		362,000
Miscellaneous items, including lighting, telephone line, etc		110,500
		19,876,290
Engineering and contingencies, 10 per cent		1,987,710
Total		21,864,000

Estimated cost of annual maintenance, $160,000.

AMOUNT OF COMMERCE AFFECTED.

In the Newport engineer district, during the calendar year 1908, there was carried by water to and from the localities undergoing improvement by the United States a total of 6,587,177 tons of freight valued at $215,009,093, of which 4,587,763 tons valued at $26,073,351 was coal and other fuel. Of this, 1,637,915 tons of freight valued at $7,574,492 was carried to and from points east of Narragansett Bay, to New Bedford and points along the Vineyard and Nantucket Sounds, and would probably be less affected by the construction of the canal than that going into the bay.

The part entering and leaving Narragansett Bay was 4,949,262 tons, valued at $170,944,159, of which 3,342,992 was coal and other fuel, valued at $18,498,857. In thus distinguishing between the freight bound for Narragansett Bay and that going east to the Vineyard and Nantucket Sounds, it should be stated that a large part of the coal included in the latter is brought into Narragansett Bay in tows, a portion of which remains there and the balance is carried to the east, involving a trip from Point Judith into Newport and out to Brentons Reef again, so that tows to be so operated would probably be benefited to a small extent by the use of the proposed canal.

Careful investigation of the cost of coal in Providence places anthracite at $5.65 per long ton and bituminous at $3.70 per long ton in the yard.

PRESENT DELAYS.

Tows of barges coming through Long Island Sound—and most of the anthracite coal bound for Narragansett Bay comes in that way—are frequently detained at the eastern end of the Sound, and at Newport in returning, a considerable time awaiting favorable weather to make this passage. The delay at times amounts to a week or more, and one case during the past year is cited by the Board of Trade of

[1] If the State pays for road changes, this item will be reduced $80,000.
[2] If the State pays for land damages, this item will be eliminated.

Providence in which a delay of three weeks occurred at New London awaiting favorable weather.

During the year 1910, the log of the tug *W. E. Gladwish*, of the Keeler Transportation Co., shows that she was delayed 738 hours waiting at Newport or New London for suitable weather to go around Point Judith. The required time as given by the master for the round trip from New York to Providence, without delays, is 90 hours east and 30 hours west, 120 hours, so that by reason of this delay 6.15 round trips were lost. The boat towed during the year in 24 round trips about 57,000 tons of coal, or 2,365 tons per trip, so that the cost of delays was equivalent to the loss of freight on about 14,545 tons at 40 cents per ton, about the average rate, or $5,818.

The tug *Elmer A. Keller* of the same line lost 438 hours between March 1, 1910, and January 1, 1911, waiting for weather suitable to go round Point Judith. The time required for this tug to make the trip east is 60 hours and for the trip west 28 hours, or 88 hours for the round trip, so that 5 trips were lost during the period. The *Keeler* towed 130,807 tons to Narragansett Bay in 43 trips, or 3,042 tons per trip, so that the delays were equivalent to the loss of freight on 15,210 tons, or $6,084, during the 10 months she was engaged in the work.

With a protected way and uninterrupted trips these two boats could have towed 217,562 instead of 187,807 tons which were towed, and assuming a 40-cent rate on what was actually towed, the cost of the larger amount would have been 34.4 cents per ton, a saving of 5.6 cents per ton. The passage through the exposed portions of the route requires from 12 to 15 hours. Changes of weather conditions during this time of transit have caused the total loss of many box barges, and the elimination of this marine risk would permit a considerable further reduction in freight rates.

Large quantities of bituminous coal are brought from Philadelphia, Baltimore, and Norfolk in barges of a build sufficiently substantial to withstand a considerable sea voyage, towed by costly sea-going tugs. The construction of the New Jersey section would bring Philadelphia 140 miles nearer Providence by water than at present, and, with the Rhode Island canal, would afford a protected way which would permit the use of light types of both barges and towboats. The addition of the Delaware section in like manner would bring Baltimore 250 miles nearer Providence by water and would make both Baltimore and Norfolk accessible by the protected route.

The freight rates as quoted in the Coal Trade Journal of January 11, 1911, from New York to Providence are 35 cents to 45 cents; Philadelphia to Providence, 70 cents to 75 cents; Baltimore, 75 cents to 80 cents; Norfolk, 70 cents to 75 cents. The distance from Philadelphia by sea is about 400 statute miles and by canal would be about 260 miles, a saving in distance of about 35 per cent; assuming the rate to be based on the distance, a corresponding reduction of the Philadelphia rate would result in a rate from 45.5 cents to 48.6 cents. The Baltimore distance by sea is about 600 miles and by canal about 350 miles, a saving of nearly 42 per cent, and upon the same assumption the rates by canal would be from 43.5 cents to 46.4 cents. The present ton-mile rates from Philadelphia are rather

higher than those from Baltimore as determined from these published rates. The Norfolk distance would not be materially changed by reason of these two canals, but the insurance rates would be less.

The chief function of the Rhode Island section in relation to the southern coal traffic would be to complete the protected waterway from the south into the waters of Narragansett Bay, with the previously mentioned decrease of cost of freight carriage.

At the present time the railroads practically control the freight movement between New York and Narragansett Bay. This is due to various causes, one of which is the difficulty of obtaining wharfage space at the terminals and another is the large capital required for the type of boat needed. Providence and New York are now endeavoring to supply greater public-wharf space. A protected water route would diminish the investment required in ships, thus stimulating competition.

The report of the Division of Statistics and Accounts of the Interstate Commerce Commission for the year ending June 30, 1907, gives the ton-mile railroad revenue for Group I (New England) as 1.145 cents, the highest in the United States excepting Group X (California). The average ton-mile railroad revenue for the whole United States is given as 0.759 cent and that for the New York, New Haven & Hartford Railroad alone is given as 1.436 cents.

The citizens of Pawtucket, where a very large amount of freight originates, contemplate the establishment of an independent line, and the American Electrical Works, at Phillipsdale, on the Pawtucket River, are now running a line of small steamers to and from New York for their own freight, which during 1910 transported 25,317 tons; but these small vessels experience considerable delay on account of storm conditions and are often obliged to await favorable weather at Dutch Island and New London.

The Providence Board of Trade states as the reason why shipments by rail are greater than by water from Providence:

> Rail shipments to this territory far exceed the water-borne freights. The reason for this is that greater expedition is secured for all-rail shipments, while there is lamentable lack of bottom to carry by water. Rates by rail are acknowledged to be much higher than by water; but the uncertainty of securing water-borne consignments on time, because of lack of merchant marine and the liability of delays through storms and stress of weather, causes a preference for all-rail transportation. Cotton men, in particular, say that they order their consignments forwarded by rail, even at greater cost, rather than risk delay of arrival.

The great consideration is the demand for dispatch and the ability to run on schedule time without the delays incident to stormy weather. It is stated by the Providence Board of Trade that the total freight transported by rail and water in Rhode Island during 1909 was 18,000,000 tons. More than 95 per cent of the total product of its manufacturing establishments was shipped out of the State, and to a very great extent by rail. The value of these manufactured products was $275,000,000. The outgoing freight by water was comparatively small, and is estimated as approximately 600,000 tons, of which 362,776 tons were shipped from Providence by steamer.

The question as to the estimated proportion of freight that would be carried by water if the Rhode Island canal were constructed is stated by the same authority as hardly possible of being answered satisfactorily. Transportation agents of recognized ability and

authority "agree, however, that its construction would result in a very large quantity of merchandise being forwarded via the waterway, not only in the form of cotton, coal, and other raw material, but as the finished products of Rhode Island and New England industries, destined for the cities of the South and West to be reached by the intracoastal waterway, and which could be shipped by the canal at much less expense to the consumer."

Apparently the water rates on package freight are maintained at the present high figures more with a view to approximating the railroad rates than to affording a reasonable profit on the cost of transportation. It is claimed by the Board of Trade of Providence that the distribution of coal from Providence is falling off and more is being delivered by all rail from the mines. An illustration of the method by which this is made profitable is given in a report on the "Buying and Handling of Steam Coal," by the committee on fuel supply of the Boston Chamber of Commerce, in which the all-rail rate from Pittsburgh to Worcester, Mass., is given as $3.10 per ton, and the rail and water route between the same points as follows:

Pittsburgh to Philadelphia	$1.65
Vessel rate, Philadelphia to Providence, March, 1909	.50
Cost of discharging and weighing	.21
Rail rate, Providence to Worcester	.85
Total rail and water	3.21

For purposes of comparison the ton-mile rates of the above would be about as follows:

Pittsburgh to Philadelphia, about 354 miles, ton-mile rate 4.66 mills.
Philadelphia to Providence, about 400 miles, ton-mile rate 1.25 mills.
Providence to Worcester, about 44 miles, ton-mile rate 19.32 mills, and the 19.32 mills rate is after paying a charge of 21 cents for transfer.
Pittsburgh to Worcester, about 635 miles, ton-mile rate 4.88 mills.

It is stated by the manager of one of the largest coal carrying concerns in New England that the railroads maintain a rate for coal from New York to Boston of 50 cents per ton, and exceptional rates of 65 cents per ton by barge have been paid.

Inquiry has been made as to the views of individuals and corporations believed to be interested in the project and 86 replies have been received. Of these 30 were in favor of the proposed canal, 11 were opposed, 23 expressed no opinion from lack of knowledge or lack of interest in the project, and 22 indicated reference to committees to communicate at a later date.

The arguments from the sources in favor of the canal, the most elaborate of which is from the Providence Board of Trade (see Appendix B 1), are in general terms that a population estimated at 3,000,000, including Boston, would be benefited; that the freight carried from and to Rhode Island is about 18,000,000 tons per year; that of this about 5,000,000 tons is carried by water; that the construction of the proposed canal would greatly increase the shipments by water and would decrease the freight rates from 20 to 66⅔ per cent; that there would be a saving in time and insurance, especially if the whole chain of canals were built; that capital for industrial development would be attracted to the line of the canal with increase of population and general benefit and that it would greatly contribute toward the saving of life and property. The arguments of those who oppose

the canal are that it would be closed by ice in winter, give slower transportation, factory sites are not needed, no development of manufacturing would take place, there would be no saving of time or insurance, canal would not be wide or deep enough, expenditure not justified, and railroad rates are now as low as water rates.

The arguments in favor of the canal come from the Providence Board of Trade, the mayors of the cities of Pawtucket and Central Falls, R. I., the Business Men's Association, Merchants' Association, and large coal and lumber dealers and users in Pawtucket, the Penn Gas Coal Co., of Philadelphia; Progressive Harbor No. 9, American Association of Masters, Mates, and Pilots, Norfolk, Va.; the Massachusetts State Board of Trade, the Worcester (Mass.) Board of Trade, and many individual dealers and users of materials brought to and shipped from Narragansett Bay and its vicinity.

The principal arguments opposed to the canal are from the Board of Underwriters of New York, whose president states:

> Our surveyors, who are ex-sea captains, make the following report:
>
> "At least four and one-half months of the year the northern part of the canal would be closed by ice, and this, too, at the most stormy time of the year, when vessels should have the most need of such a waterway. The extra time used in steaming or towing through a canal is also a great factor. The opening up of manufactories and the general development of the country requires more careful study and attention than the mere fact of a canal as above indicated. This country is interwoven with railroads and natural waterways. Factory sites can be obtained at small cost near the water fronts to last the country for the next century; at least such is our judgment. The coastwise fleet can take care of this trade and be enlarged from time to time as required. From a strategic point of view, in case of war, a small quantity of dynamite could be effectively used to close up the canal." Considering the enormous cost of this undertaking, they do not think that our Government would be justified in building it. However, if the canal is to be built, by all means make it as deep as possible to admit ships of the greatest draft. This is the judgment of these ex-mariners, who seem to have clear vision of what the requirements should be. This is the best information we can give you on the subject.

Mr. W. G. Besler, vice president and general manager of the Central Railroad of New Jersey, states:

> Proposition No. 1, which calls for a canal 18 feet deep and 125 feet bottom width, would be useless for our fleet of coal-carrying barges, for the reason that it is neither deep enough nor wide enough to be navigated with safety.
>
> Proposition No. 2, which calls for a canal 25 feet deep and a bottom width of 200 feet, would likewise be of no value in our business for the following reasons:
>
> The barges could not be towed tandem, as they are now handled, but would have to be towed three abreast, and as each barge has a beam of 35 feet, which would make a tow 105 feet wide, it would not leave sufficient space for two tows to pass. One of our barges has a beam of 47 feet, and whenever this barge made the third in a tow, it would increase the width of the tow to 117 feet.
>
> Another matter to be considered is the probable cost to the vessels passing through this canal. The tolls would probably amount to at least 4 or 5 cents per ton and at the present rate of freight received to all the eastern points I do not think that the time saved to our boats in passing through the canal would compensate for the increase in operating expenses.

Communications addressed to others of the large shipping and handling corporations have not been replied to other than by simple acknowledgment or the statement that the inquiries had been referred to certain departments of the company.

With regard to what assistance might be expected from State or municipal governments in the execution of the project, there is submitted herewith a letter from Gov. A. J. Pothier, of Rhode Island, with accompanying papers. (See Appendix B 2.)

House Doc. No. 391 ; 62d Cong., 2d Sess.

The objections offered to the construction of the proposed canal seem to be based on the theory that the existing means of water transportation are better adapted to existing routes than they would be to a canal, without consideration of the benefits to be derived from the development of an efficient type of vessel, especially suited to canal transportation, a vessel of low cost as compared with those built for service on the ocean. This has already been done in Europe.

The danger of obstruction from ice during the winter months is not believed to be greater than in the quiet reaches of the rivers in the same latitude, nor in fact as great, in consequence of the water being more salt in the canal. The Taunton River in this vicinity is rarely closed by ice.

Tows of barges in the passage now from New London to Newport have a speed which rarely exceeds 3 to 4 miles per hour, and unless the sea is very smooth the rate is even less. Such a rate is common in canals of the type and dimensions proposed.

The depth of the canal has been placed at 18 feet to accommodate freight carriers drawing from 14 to 16 feet. Deeper-draft vessels or vessels moving at speed can take the outside route with safety.

NEW YORK BAY-DELAWARE RIVER SECTION.

The advantage of connecting the navigable waters of the Delaware River with those of New York Harbor, of joining by sheltered waterways the markets and manufactures of the communities along the Delaware with the port of New York, and so with all of the territory commercially tributary thereto, has long been advocated. In 1830 the Delaware & Raritan Canal Co. was incorporated by an act of the Legislature of New Jersey, and was authorized to construct a canal "from the waters of the Delaware River to the waters of the Raritan River and to improve the navigation of said rivers, respectively, as may from time to time become necessary, below where said canal shall empty into said rivers respectively;" to construct a feeder canal, and to make all auxiliary works necessary for the use of the canal and feeder.

By an act of February 15, 1831, this company was consolidated with the Camden & Amboy Railroad and Transportation Co. The canal was constructed and opened to traffic in 1834. It was required to have a depth of 7 feet and a surface width of 75 feet. The locks were to be 100 feet long and 24 feet wide. Under acts of 1867 and 1872 the joint companies operating the canal were consolidated with another company under the corporate name of the United New Jersey Railroad & Canal Co. In 1871 all the property of this company was leased to the Pennsylvania Railroad for a period of 999 years. The canal, as existing to-day, extends from the Delaware River at Bordentown to the Raritan River at New Brunswick, a distance of 43 miles. The feeder, which is also navigable, extends from Bull Island in the Delaware to the canal at Trenton, a distance of 22 miles. The main canal has a surface width of about 80 feet, a bottom width of 50 feet, and a depth of 9 feet. It has 13 locks, each 220 feet long and 24 feet wide, with a depth of 7½ feet on the miter sill. The total distance from Philadelphia to deep water in New York Bay by this route is 93 miles, of which 26 miles lie in the Delaware River, 43 miles are canal, and 24 miles are in the Raritan River and Bay.

The history of the canal shows a continuous growth of commerce with but few and unimportant setbacks to a maximum of 2,857,233 tons in 1866, when the earnings were $1,294,156.69 and the operating and maintenance expenses $360,513.83. In that year the coal tonnage was 2,282,203, or 83 per cent of the total. In 1872, immediately after the lease to the Pennsylvania Railroad, the tonnage went up to 2,837,532 tons, but the earnings were $938,832 and the expenses $522,318. From the year of the lease the tonnage carried has generally declined. The total tonnage for 1909 amounted to 400,000 tons; the revenue was $70,000; and the expenses $180,000. (Report of the committee appointed to investigate the Delaware & Raritan Canal, to the Senate of New Jersey, Apr. 18, 1911.)

Various reasons have been given for the decline of traffic, the most potent of which is probably the fact that the dimensions of the canal are insufficient to pass boats of a size great enough for the economical transportation of freight by water.

The inadequacy of the Delaware & Raritan Canal to meet the requirements of the water traffic between Philadelphia and New York led to an agitation for a new waterway. In 1894 the city council of Philadelphia passed an ordinance authorizing the mayor to appoint a commission to make surveys of a route for a ship canal between the Delaware River and the Atlantic Ocean and to submit a report and recommendations thereon, and appropriated $10,000 for this work. The commission made its report in 1895. It reported in favor of a route from Bordentown to the Raritan River near its mouth, following a line nearly parallel to the Pennsylvania Railroad and on the southeasterly side thereof to a point near Monmouth Junction, where it turns easterly, passes down the valley of Lawrence Brook to Parsons Dam (which forms a long pond), thence northeasterly on higher ground to the Raritan River at Sayreville. The total distance by this route between Philadelphia and deep water in New York Bay is about 77.4 miles, of which 26 miles are in the Delaware River, 31.4 miles require a canal, and 20 miles are in the Raritan River and Bay. From borings taken along the route it was found that between the Delaware River and Princeton Junction the subsoil consists of sand, gravel, and clay to a depth of 28 feet above sea level; from Princeton Junction to near Milltown, red shale and sandstone were found at various depths above +28; and from this point to the Raritan River, red shale and sandstone were found in a number of places above sea level.

Plans and estimates were submitted for 2 sizes of canal prism; one 96 feet wide at bottom, 150 feet wide at water surface, and 20 feet deep in center for vessels not exceeding 18-foot draft; another 100 feet wide at bottom, 184 feet wide at water surface, and 28 feet deep, for vessels not exceeding 26-foot draft. In both cases there was to be a berm on one side 12 feet wide. One level was proposed practically from river to river at an elevation of 56 feet above mean sea level at Sandy Hook or 60 feet above low water in the Delaware near Bordentown. Both projects contemplated reaching this level by 3 locks of 20-foot lift each, at each end of the canal. It was proposed to economize in both water and time by the use of locks of 2 sizes for the 20-foot canal and an additional one, making 3 locks abreast, for the 28-foot canal. These locks were to have the following dimensions: No. 1, 205 by 24 feet with 10 feet on miter sill;

No. 2, 340 by 44 feet with 20 feet on miter sill; and No. 3, 500 by 65 feet with 28 feet on miter sill. The slopes throughout were to be made at the ratio of 1½ to 1, and the banks below water surface were to be protected from wash by stone pitching. The locks were to be founded on piles, with timber grillage and flooring. The masonry was to consist of ashlar facing, quoins, etc., with rubble backing. The gates were to be of modern design of iron or steel. The locks were to be filled and emptied by culverts and pipes, as well as by valves in the gates, which, together with supply and discharge pipes, would be operated by hydraulic power applied in the usual manner for such purpose. It was proposed to provide an electric plant with lights about the locks and at each quarter mile along the canal line. Suitable buildings for machinery, attendants, etc., were also included. It was found that the country adjacent to the canal was not suitable for the formation of an impounding reservoir of sufficient capacity to supply the water required. Therefore, it was proposed to build a dam on the upper Delaware River and to enlarge the feeder of the Delaware & Raritan Canal, which it was presumed could be done under proper reservations as to the existing rights.

The engineers' estimates of the cost of the work as outlined above was, for a canal with a depth of 20 feet, $14,574,000, and for a canal with a depth of 28 feet, $24,124,700. These amounts are for the canal section from the Delaware River near Bordentown to the Raritan River near Sayreville. The annual cost of maintenance was estimated at $250,000 in each case.

The estimate for the 20-foot waterway includes both the smallest and intermediate size locks, or 12 locks in all, with 14 road bridges, 2 railroad drawbridges on branch roads, reservoir, feeders, a dam covering 2 miles of channel, a tunnel, the right of way, and other contingencies. The only difference between the 20-foot canal and the 28-foot canal was that the latter had 18 locks, while the former had but 12.

The board was able to obtain the information concerning this survey through the courtesy of Prof. L. M. Haupt, engineer in charge of survey.

PRESENT INTRACOASTAL WATERWAY PROJECT.

In accordance with the recommendations of the Board of Engineer Officers, constituted by paragraph 1, Special Order No. 10, Office Chief of Engineers, March 8, 1909, charged with the preparation of the project and report on the Boston-Beaufort inlet division of the proposed intracoastal waterway, the duty of making the survey for the portion of the route from New York Bay across New Jersey to a suitable point on Delaware River or Bay, was, on April 1, 1909, assigned by the Chief of Engineers to the New York district No. 1. The first work done was to make a general reconnoissance of that section of New Jersey through which the canal would run from the Delaware River to New York Bay, covering an area of 350 square miles.

The board believes that should a canal be built through this populous and much-traversed section it must be located so as to eliminate as far as possible interference between the land and water traffic. Over the railroads between Philadelphia and New York passes all of the railroad traffic between the vast territory to the south and west tributary to the Pennsylvania and Baltimore & Ohio Railroad systems

and New York and the New England States. During a large part of each day the trains on the main trunk line of the Pennsylvania Railroad run under a three-minute headway. Under such conditions the use of drawbridges becomes impossible.

The board therefore laid down as a condition that the canal route should not cross any trunk-line railroad at grade; that if a trunk line had to be crossed, the crossing must be at a point where either the railway could be depressed sufficiently to permit a canal of the maximum depth probably to be required in the future to be built over the railway, or at a point where the railway could be elevated sufficiently to permit the construction of a fixed bridge with clear height under it sufficient for all classes of shipping using the canal.

The board also believes that it is undesirable to have the canal pass directly through any large city on account of the interruptions to traffic in the streets and on the canal by reason of drawbridges, as well as of the cost of operation and maintenance of such bridges; and that for any type of canal adopted the route selected should be such that the canal could be deepened and widened, or, if a canal with locks, converted to a sea-level canal at a minimum cost should navigation warrant such changes.

A careful study was made of the route recommended by the city of Philadelphia, as outlined above, and a rough survey was made over it to verify the contours. It was found that at present there would have to be three railroad crossings, two crossings of an electric railroad, operated under a steam-railroad charter, which might be double-tracked at any time, besides two crossings of the proposed Pennsylvania freight line and three trolley crossings. One of the crossings of the proposed Pennsylvania freight line would come at a point where a bridge could be constructed only at very great expense to the canal project or with a serious change of grade of the railroad. It was also found that the rock formation between Princeton Junction and Monmouth Junction would make a sea-level canal impracticable on this route and that the cost of a canal on this route would be greater than the cost of a similar canal on a route farther to the east. After careful consideration this route was rejected.

An investigation was made of the conditions of the existing Delaware & Raritan Canal with the view of determining whether this canal could be altered and adapted to modern requirements economically and advantageously. The following adverse conditions were found:

(*a*) At New Brunswick the main trunk line of the Pennsylvania Railroad crosses the canal on a fixed bridge with a clear headroom beneath of 69 feet. The minimum headroom required to pass schooners with lowered topmasts is about 105 feet. The railway can not be elevated without enormous expense and the canal level can not be lowered more than a very few feet.

(*b*) At Trenton the main line of the Pennsylvania Railroad is again crossed. The tracks have been depressed and the canal crosses the line with a minimum of headroom beneath. At this crossing in Trenton, the railroad tracks are as low as it is practicable to place them under existing conditions. The canal depth is 7 feet. To obtain greater depth for the canal, the surface would have to be elevated. The property on the canal banks is very valuable and is utilized for factory sites. The cost of obtaining enough additional land to provide for a wider and deeper canal would be prohibitory.

Further study failed to show where another crossing under good conditions could be made.

(*c*) For 12 miles this route uses the Raritan River and for 8 miles further skirts its banks. This stream is tortuous and subject to floods. The cost of improving the river, enlarging the canal and protecting it would be very great.

(*d*) For 16 miles the canal line skirts the Millstone River, where similar protecting works would be required.

(*e*) In Trenton, in addition to the great cost of acquiring a right of way for an enlarged canal alluded to above, the canal is crossed by 11 drawbridges connecting the streets cut by the canal line. The interruptions to street traffic by the very small existing canal traffic are a cause of annoyance and loss to both land and water commerce. This condition would be intolerable were the canal traffic much increased in volume.

(*f*) Though the line can be shortened without great expense by cutting across a long bend near its northern end, it yet would be longer than a route to the eastward, and since navigation through narrow channels must be slow, this becomes of importance.

After a consideration of all of the above, the board decided that the adoption of this line would not be economical or advantageous. Surveys were then made from the Delaware River near Bordentown to Raritan Bay near Morgan, covering every feasible route between the proposed Pennsylvania freight line and the Camden and Amboy division of the Pennsylvania Railroad for canals with a summit level of 70, 80, 90, and 100 feet, and for a sea-level canal. In all, over 250 linear miles of ground were covered by the surveys. It was not necessary to make any surveys to the east of the Camden and Amboy division of the Pennsylvania Railroad between Jamesburg and Bordentown, as the ground rises to such a height that it would make the cost of any type of canal prohibitive.

DESCRIPTION OF ROUTE SELECTED.

The route selected runs from a point on the Trenton and Bordentown branch of the Camden and Amboy division of the Pennsylvania Railroad in a general northeasterly direction up the valley of Crosswicks Creek, to the highlands at Hutchinson mill pond; thence continuing in a general northeasterly direction through the highlands passing to the east of Edinburgh, about midway between Princeton Junction and Heightstown, and about 2 miles west of Cranberry to a point about 3 miles west of Jamesburg; thence in a general northeasterly direction, passing through the valley of Manalapan Brook and South River to a point 1 mile east of Runyon; thence continuing in a general northeasterly direction over the highland near Cheesequake Creek and through the valley of Cheesequake Creek to New York Bay. The length of the line across New Jersey is 33.7 miles. This route was selected because it was the line of least resistance. It is also the cheapest route that could be found that fulfilled the requirements of the board for either a 70-foot lock canal or a sea-level canal. There are no bad bends to interfere with navigation; no towns are passed through; no rock was found along the entire length of the canal from the surface to a depth of 25 feet below mean low water, borings having been taken approximately every 1,000

feet. Throughout the route unused land is found where spoil can be wasted with short hauls.

The streams which are crossed are insignificant and their maximum flood discharge can be carried across the canal line in inverted siphons with but slight difficulty and expense. At the northern end the approach is through the Raritan Bay (New York Lower Bay) and Cheesequake Creek, a small tidal creek not subject to floods. The Delaware is entered at Bordentown below the portion of the river subject to heavy ice gorges, below the portion of the bed formed in rock and where the tidal flow will permit river improvement to any desired depth.

No trunk lines of railroads are crossed. At the south end the line is crossed by the Trenton and Bordentown branch of the Camden & Amboy Railroad, a local road with comparatively light traffic. This can be accommodated by a drawbridge. At Jamesburg the Monmouth Junction and Camden and Amboy divisions of the Pennsylvania Railroad cross the line. The former carries a large express passenger traffic during the summer months as well as freight, which at Jamesburg passes to the Camden and Amboy division. The traffic of the latter road is mainly heavy freight. By the construction of about 6 miles of railroad it will be possible to form a junction of these two roads and carry them across the canal line on a bridge which will have a clear height beneath it of 110 feet, with grades and location, which the engineers of the Pennsylvania Railroad state will be an improvement over the existing conditions.

At the northern extremity, the line is crossed by the Long Branch division of the Central Railroad of New Jersey. This road, which has comparatively heavy traffic in the summer time only, can be accommodated by a drawbridge. Later, if necessary, it could be passed below the canal line by tunnel.

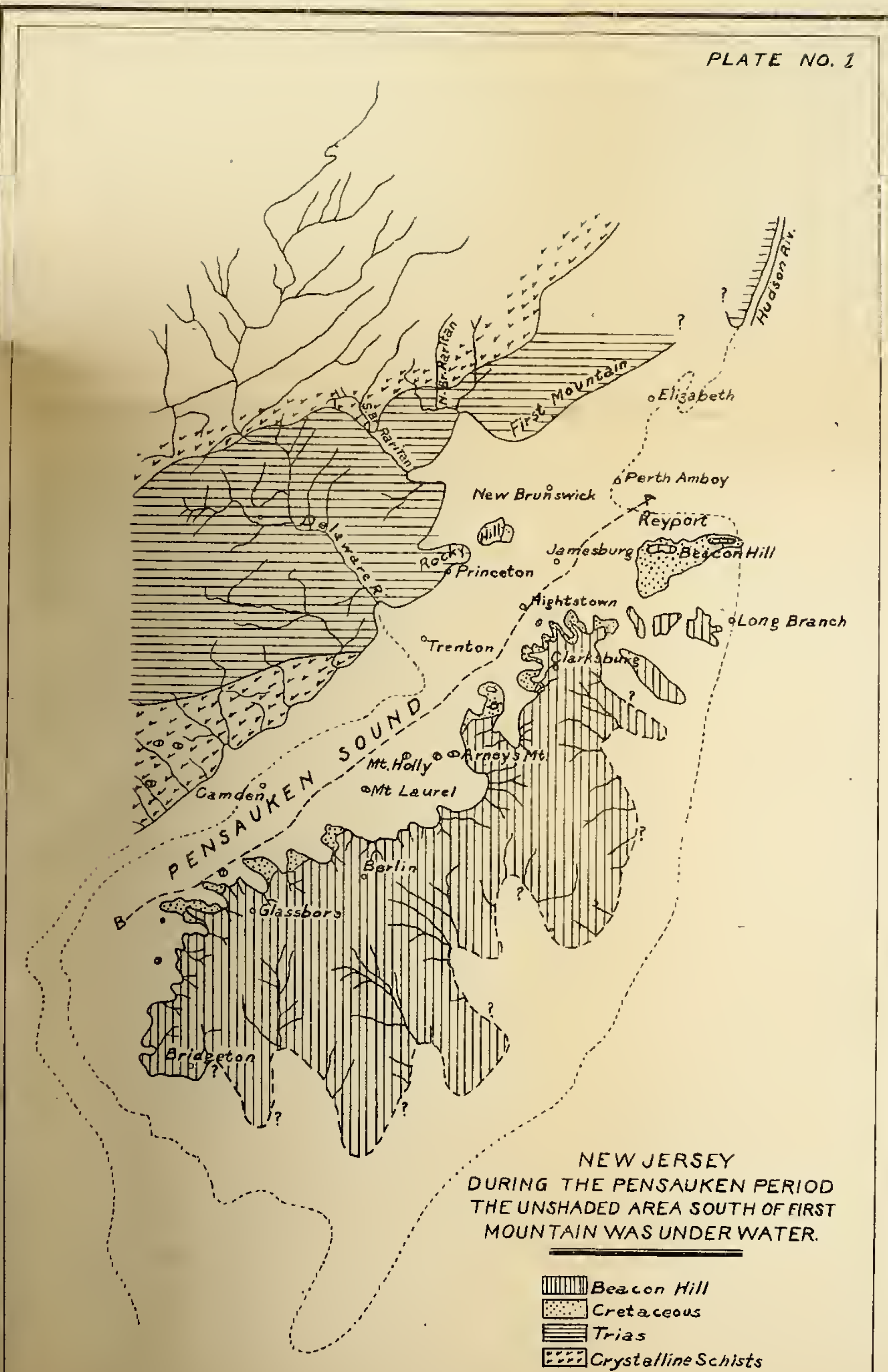
The canal line enters and leaves the high land of the State through natural valleys, and between their extremities follows a series of slight depressions in the terrain.

An examination was made of the subsoil of the section of New Jersey through which the canal passes. In all 211 borings were made, spaced about 1,000 feet apart and generally carried down to 25 feet below mean low water of the ocean. The borings aggregated a total length of 11,945 linear feet.

The only materials encountered were loam, sand, clay, and very little gravel, with a few bowlders near the Delaware River end of the canal.

The absence of rock in the section of the country through which the canal passes is due to the fact that it follows the geological formation known as "Pensauken Sound." (See pl. 1.) This also accounts for the absence of rock in the Delaware River, which will be spoken of later. Much assistance in making the canal line location was obtained form the excellent reports and maps of the New Jersey Geological Survey, and the board desires to acknowledge its indebtedness to Dr. H. B. Kümmel, director, for many courtesies shown.

The location of the canal having been fixed, it then became necessary to determine the size and type of canal—whether sea level or lock. The board decided that a canal, to have commercial value, should have a bottom width of at least 125 feet; that the side slopes should be 1 on 2 from the bottom of the canal to a berm 15 feet wide, 15



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feet above low-water level; that above the berm the side slopes should be 1 on $1\frac{1}{4}$, with berms 10 feet wide at each 50 feet vertically.

To determine the type of canal the board ordered comparative estimates to be prepared for a sea-level canal 125 feet wide, with depths of 18 and 25 feet, and for a lock canal of the same dimensions.

Investigation showed that if a lock canal should be adopted, its summit level should be at an elevation of 70 feet, and should extend from near Jamesburg to White Horse, near Bordentown, with sea-level canal approaches, and that the summit level should be reached by a single flight of two locks of 35-feet lift each at each end. The dimensions adopted for the lock chambers, as designed for both the 18-foot and 25 foot depths of canal, are 600 by 75 feet, with a depth over the miter sills of 27 feet. Intermediate gates are projected, so placed as to make a flight with chambers having either 175 feet or 375 feet usable lengths, and thus economize the use of water when small boats are to be passed. The gates were designed to be of metal, of the miter type, similar to those adopted for the Panama Canal, and to be operated mechanically. The main culverts, 15 feet in diameter, extend from fore bay to tail bay through the side walls and are provided with stoney gate valves. These are connected with the chamber by 7-foot culverts, spaced 30 feet apart and provided with cylindrical valves. The branch culverts pass across the lock in reenforced concrete floor slabs, having openings into the spaces between the slabs sufficient to cause the water level in the lock to change at the rate of 5 feet per minute. The walls are of 1–3–5 concrete. Emergency gates are provided at each end of each flight. Guide walls 600 feet long, formed of concrete piers, spaced 10 feet apart and joined on top by a concrete pavement, are also provided at each end of each flight. The foundations of all of the walls and floors are on piles.

The amount of water which would have to be supplied to the summit level daily was calculated to be 600,000,000 gallons. The discharge of the streams crossed was insufficient. It was also found to be impracticable to impound a sufficient supply in storage reservoirs located within the State, and at a sufficient elevation to discharge into the canal by gravity. Two other sources of supply remained, i. e., by gravity flow from the higher levels of the Delaware River and by pumping.

The Delaware & Raritan Canal feeder was gauged at Raven Rock, N. J., at the intake from the Delaware River, and also at a point in the feeder just above the entrance to the canal, and it was found impracticable to utilize any portion of this feeder as a means of supplying water to a 70-foot level. The Delaware River was gauged at Reiglesville, N. J., and at Byram, N. J., the flow being about 2,000 cubic feet per second. A survey was then made along the Belvidere Division of the Pennsylvania Railroad from Reiglesville to Trenton to determine a route for a gravity system. It was found that by constructing a concrete dam 1,700 feet long across the Delaware River near Holland Station a feeder 51 miles long capable of carrying 980 cubic feet of water per second could be constructed. Such construction would necessitate the use of open cuts, rock tunnels, impound basins, reenforced concrete siphons, and overhead conduits to supply the requisite amount of water to the canal, namely, 600,000,000 gallons per day. The cost of this feeder was estimated

at $10,000,000, which is somewhat greater than the estimated first cost of an adequate pumping plant plus the capitalized cost of operating. Owing to the tunnels and siphons, which would be imperative in a gravity feeder, and the fact that the lock canal might be converted into a sea level canal at any time and that this might be done at the expiration of the life of a pumping plant (which is about 10 years), the board eliminated the gravity supply system, and the estimates for the lock canal were prepared providing for a water supply delivered by pumping.

As noted earlier in this report, the canal line connects with the Delaware River at Bordentown in tide water, the mean tidal range there being 4.8 feet. The tidal movement in the river ceases at the falls at Trenton, 6.5 miles above Bordentown, where the mean range is about 4.5 feet. Although the lowest low-water discharge of the Delaware at Trenton is small, 1,300 feet per second, this tidal movement maintains the Delaware River under all conditions as far as Trenton as a noble stream, capable of improvement to any desired extent.

From Philadelphia the river follows a general northeasterly course to Bordentown. As far as Mud Island, 2 miles north of the Philadelphia city line, the channel has at present a minimum depth of 18 feet with several long reaches in which a depth of 25 feet is found. North of Mud Island there is at present a minimum depth of 10 feet. Above this to Kinkora Bar, a distance of 22 miles from Philadelphia, a minimum depth of 12 feet now obtains. There is a depth of 10 feet over this bar and above it a depth of 12 feet to within one-half mile of Bordentown. From here to Trenton a minimum depth of 7 feet can be carried. In most cases the banks of the river are firm and rise abruptly from low water to an elevation of +10 or +15. Where this does not obtain they are generally well protected by vegetable growth and are subject to little change.

The upper part of the river is subject to floods at intervals of from one to three years. The following is a table of the heights of floods at Bordentown, N. J.:

Freshet heights at Bordentown, N. J.

Date.	Elevation.	Date.	Elevation.
Spring, 1676	14.1	Oct. 15, 1869	15.9
March, 1692	18.3	Dec. 11, 1878	16.1
Oct. 27, 1777	13.4	Oct. 21, 1879	12.9
May 9, 1781	14.6	Mar. 2, 1882	13.4
Feb. 29, 1783	13.8	Apr. 14, 1885	12.2
Mar. 17, 1785	14.9	Feb. 14, 1886	13.1
Oct. 4, 1786	14.1	Apr. 1, 1886	12.3
1798	13.6	June 6, 1886	11.8
1801	13.9	Sept. 18, 1888	12.7
Apr. 1, 1814	13.9	January, 1891	12.1
March, 1832	11.7	Mar. 12, 1893	12.2
April, 1836	14.1	Apr. 9, 1895	15.3
April, 1839	18.0	Feb. 6, 1896	15.9
Jan. 8, 1841	18.7	Mar. 1, 1896	11.7
Oct. 13, 1843	13.9	Mar. 2, 1900	10.7
Oct. 13, 1845	13.0	December, 1901	15.2
Mar. 15, 1846	15.6	Mar. 1, 1902	16.9
Mar. 3, 1857	13.8	Oct. 10, 1903	19.8
July 20, 1860	14.0	1905	11.6
June 3, 1862	17.5	1907	12.7

The original navigable depth of the Delaware between Philadelphia and Trenton was limited to 5 feet by numerous bars, caused mainly

by river flood action, with deeper reaches between. At a few points shoaling is caused by an undue width of thalweg and at others by the existence of side channels. These conditions yield readily to treatment by dams and dikes. Improvements made in the past have increased the minimum channel depth to 7 feet, and in the river and harbor act of June 25, 1910, Congress has provided for a channel 200 feet wide and 12 feet deep from Philadelphia to Lalor Street, Trenton.

In Lower New York Bay, at the north end of the canal line, the mean range of tide is 5.1 feet. The mean low-water level is 2.3 feet below the mean sea level of the Atlantic Ocean at Sandy Hook. The highest known high water reached reference 6.4 above mean low water at Sandy Hook (used as the plane of reference); the lowest recorded low water fell to -1.3 feet below the same plane. The time of high water is 7 hours 40 minutes after lunar culmination at New York.

At Bordentown, as stated, the mean range of the tide is 4.8 feet. The mean low-water level is at $+0.19$ feet, referred to mean low-water level at Sandy Hook. The highest high water and the lowest low water recorded are at references 19.8 feet and -2.2 feet, respectively. The time of high water is 4 hours 7 minutes after lunar culmination at New York.

To obtain some idea of what would be the rate of progress of the tidal wave through a sea-level canal, the recorded rate of progress through certain reaches of the Connecticut, Hudson, Savannah, and St. Johns Rivers were examined. The rate was found to be a function of the depth, and the mean rate for a given depth was found to be expressed in the following formula, viz:

$v-.678\sqrt{gh}$ where v = velocity of tidal wave.

g = acceleration due to gravity = 32.185.
h = mean depth of water.

From this it would appear that the tidal wave would pass through a sea-level canal 25 feet deep at the rate of 13.4 miles per hour and that 2.5 hours would be required for the wave to move from Bordentown to the north end of the canal, so that the wave propagated through the Delaware Bay by any one tide would meet the wave of the succeeding tide propagated through the Sandy Hook entrance to New York Bay, near the northern entrance of the canal. Further calculations showed that the resultant movement of water in such a canal would be to the north and that the maximum tidal currents developed would probably not exceed 1.27 miles per hour, but with a possible maximum of 3.2 miles. In other words, it was found that if a sea-level canal were constructed there would be little salt water which would pass into the Delaware River and that the tidal currents would be so small as to render their control by a lock unnecessary.

It having been shown to be feasible to construct and operate a sea-level canal of the required depth, the estimates for a sea-level and lock canal were then compared. For this comparison, to the cost of the canal proper (omitting the cost of the bay and river sections) in each case was added the annual maintenance and operating charges capitalized at 3 per cent.

Estimated cost of 70-foot summit-lock canal	\$49, 463, 500
Estimated cost of sea-level canal	50, 635, 100

After due consideration, it was decided that, inasmuch as the cost of a lock canal (including the maintenance capitalized at 3 per cent) was so little less than the cost of a sea-level canal, that the time required for a ship to pass through a sea-level canal would be over one hour less than the time required to pass through a lock canal, and that the commercial bodies interested almost unanimously advocated a sea-level canal, the board decided to eliminate the lock and adopt a sea-level canal.

The question of the most advantageous depth was then taken up. In view of the railroad facilities already existing, and of the failure of the Delaware & Raritan Canal, with its small depth and width to afford relief, it is the opinion of the board that a canal which would join the North and South Atlantic seaboards and connect directly two cities of such capital importance as New York and Philadelphia, if worth building at all, should have dimensions sufficient to permit boats of from 2,000 to 3,000 tons capacity to traverse it at a fair rate of speed. Boats of this capacity will have a draft, loaded, of from 14 to 16 feet, and a beam of from 30 to 50 feet. Experiment has shown that in narrow channels the minimum ratio which should exist between the cross-sectional area of the boat and channel, respectively, is 1:4, i. e., that the area of the cross section of the channel must be four times that of the submerged portion of the boat. The following generally accepted formula, also deduced from experiments, shows that the rate of speed of a boat driven economically is also a function of the relative cross sections of channel and boat.

$V=\frac{\triangle Q+q}{Q-\triangle Q-q}D$ in which V=velocity of back flow not to exceed 3 feet per second.

$\triangle Q$=the cross section between the sunken surface, due to the boat's motion and the normal water surface.

q=the mean cross section of the boat.

Q=the wet section of the canal.

D=the velocity of the boat.

Taking a boat 45 feet beam and 16 feet draft (the size required for a cargo of 3,000 tons) with the same channel width, the allowable speed for an 18-foot depth is 5.6 miles per hour, and for a 25-foot depth 9.2 miles per hour, making a difference in the time of transit through the canal length of about three and three-fifths hours. The same results could be obtained by making the canal wider without increasing the depth, but in a deep cut, such as a sea-level canal would have on the alignment proposed, the cost of increased width is greater than the cost of increased depth; and the greater the depth below the keel, the more easily the boat can be steered and the less will be the harmful effect of the propeller on the bottom.

Should the canal be constructed with an 18-foot depth, it is reasonably certain that within a few years there would be an imperative demand for an increase of depth. To allow for this, it is probable that one or both side slopes would have to be disturbed, a serious matter in a deep cut, and one which affects the cost of maintenance through a number of years.

The estimated first cost of a sea-level canal 18 feet deep (considering the canal proper only) is $40,336,615; that of a canal 25 feet deep is $43,027,900. The cost of maintenance is about the

same for each. Considering all of the above, the board decided to recommend that the canal depth should be fixed at 25 feet, and that the approaches in New York Bay and in the Delaware River, as far as Bordentown, should be channels having a depth of 25 feet for a width of 100 feet, and of 18 feet for a width of 300 feet.

From Bordentown to Trenton the branch channel should have a depth of 18 feet for a width of 150 feet only.

For all the reasns given above, it is the opinion of the board that to fulfill adequately the demands of commerce the section of the proposed intracoastal waterway between deep water of New York Bay and deep water of the Delaware River should be in type and dimensions as follows:

Beginning in the Delaware River near Allegheny Avenue, Philadelphia, and proceeding north, there should be formed in the Delaware River a channel 300 feet wide, of which a width of 100 feet should have a depth of 25 feet at all stages and the remainder 18 feet as far as the canal entrance at Bordentown, a distance of 26 miles, and thence as far as Lalor Street, Trenton, a distance of 3.9 miles, with a bottom width of 150 feet and a depth of 18 feet only at all stages. From the Delaware at Bordentown to Morgan, at the mouth of Cheesequake Creek, in the lower bay of New York, a distance of 33.7 miles, a sea-level canal should be excavated having a depth of 25 feet at the lowest stage, a bottom width of 125 feet, and side slopes of 1 on 2 up to the level of +15 referred to mean low water at Sandy Hook, which is taken as the datum plane throughout. Above the level of +15 the side slopes should be 1 on $1\frac{1}{4}$, with a 10-foot berm each 50 feet, measured vertically. Between the levels of −7 and +12, the side slopes are to be revetted with stone to a thickness of $1\frac{1}{2}$ feet, anchored at the base by sheet piling.

From Morgan to deep water in New York Bay, a distance of 12.1 miles, a channel to be dredged of dimensions the same as those recommended for the Delaware River.

To guard against undue currents in times of freshets in the Delaware River, a lock should be built near the Bordentown end of the canal. The lock should be 600 feet long, have a clear width of 75 feet and a depth over the miter sills of 25 feet at the lowest low water. Since it is believed that the use of a lock is necessary only during periods of freshets in the Delaware River, in order that there should be no increase of tidal currents at the lock due to a contraction of the canal prism when the lock is not in use, it is proposed to construct a navigable by-pass for use during such times, to be closed by a movable dam during the freshets.

Auxiliary works which will be required are bascule lift bridges of 150 feet span, for railroad, trolley, and ordinary vehicular traffic, an electric power plant of capacity sufficient to operate the lock and bridges and to light the canal; the construction of short stretches of highway to provide for roads for which separate bridges are not contemplated; inverted siphons for conveying intercepted streams across the canal; the construction of short stretches of railroads and trolleys, where existing lines must be changed; a system of lights for the canal; a telephone line; a line of fences along the right of way; and jetties at the New York Bay end of the canal.

The work proposed and the estimates of cost in greater detail are as follows:

No rock is found along the entire length of the canal. The cost of excavating the soft materials found will vary with the methods which can be used, and these methods will vary with the elevation at which these materials lie referred to the general datum plane, the plane of mean low water at Sandy Hook. In general, locations for spoil banks can be found all along the canal line and the excavated materials can be conveyed to such localities at small expense—by pumping and rehandling or by cars. With reference to the cost of excavation, materials fall into four classifications, as follows:

Class A. Materials which lie between the canal bottom and zero, and which can be excavated and handled by pumping, for which the cost is estimated at 10 cents per cubic yard.

Class B. Materials between zero and +15 to be excavated by dry or wet dredging and rehandled, for which the estimated cost is 15 cents per cubic yard.

Class C. Materials above +15, to be excavated in the dry and hauled by cars to a spoil bank. Estimated cost 20 cents per cubic yard.

Class D. Materials to be dredged and rehandled. Estimated cost 20 cents per cubic yard.

Delaware River section.—The survey of the Delaware River from Allegheny Avenue, Philadelphia, to Lalor Street, Trenton, was made under the supervision of Maj. Herbert Deakyne, Corps of Engineers, in charge of the Delaware River improvement, and paid for mainly from the funds allotted for the intracoastal waterway surveys.

The approved project for the improvement of the Delaware River between the limits named contemplates the formation of a channel 12 feet deep and 200 feet wide, by dredging and dike construction, at an estimated cost of $327,000. The work is now under contract. Three dikes are to be built, one at the head of Biles Island, to restrict the waterway back of Biles Island to a flow only sufficient to prevent stagnation; a second from the lower end of Duck Island to the New Jersey shore above Bordentown, to contract the unduly wide channel; and a third between the upper end of Mud Island and the Pennsylvania shore, closing a back channel.

As stated earlier, the canal project calls for a channel 25 feet deep at the lowest stages for a bottom width of 100 feet, and 18 feet deep for a remaining bottom width up to 300 feet, with side slopes of 1 on 2 as far as Bordentown. From there to Trenton the bottom width is 150 feet and 18 feet deep at lowest stages. The proposed channel generally follows the line of the channel now being made, deviating from it only at points where a more direct line across a bar seems economical and at points where the natural river contours appear more favorable for the increased depth required for the canal. Five dredged cuts will be required. The material in the bed of the river is generally mud and fine sand in the lower portion, becoming coarser and harder as the river is ascended. Some clay is found, the amount of clay being greater as the distance below the natural bottom increases. Most of the material can be removed by hydraulic dredging and pumped ashore. Locations for spoil banks can be found quite generally along the river banks. The sand and gravel

from the upper river has a saleable value for building purposes The dredged cuts required are as follows: (*a*) Opposite Philadelphia, length 10,150 feet, volume 97,000 cubic yards; (*b*) opposite Wrights Corner, length 9,100 feet, volume 227,000 cubic yards; (*c*) between Torresdale and Beverly, length 16,150 feet, volume 710,000 cubic yards; (*d*) between Beverly and Bordentown, length 56,900 feet, volume 3,616,000 cubic yards; (*e*) from Bordentown to Trenton, length 20,300 feet, volume, 1,004,000 cubic yards.

The total volume of dredging is thus 5,654,000 cubic yards. Its cost, estimated as Class D, is $1,130,800. Eleven dikes are required. These generally are designed to be of the same type as those in successful use for many years in the Hudson River. They consist of two rows of sheet piling, reenforced by round piles at intervals of 5 feet, and tied and braced and cut off about 1 foot above low-water line. Stone is filled between the rows, and the crest of the stone pile is 3 feet wide and at the level of 4 feet above ordinary tidal high water. From the piling to the crest the side slopes and crest are faced and paved with concrete to prevent injury by moving ice.

The locations and lengths proposed for the dikes are as follows: (*a*) At Mud Island a dike is to extend from the Pennsylvania shore out and down the river with a length of approximately 7,000 feet; (*b*) at Delanco, a dike connecting Rancocas Neck with the New Jersey shore, length 850 feet; (*c* and *d*) two wing dikes at Delanco, length of lower 1,050 feet, of upper 1,000 feet; (*e* and *f*) at Beverly two wing dikes from the New Jersey shore, lengths 800 and 950 feet, respectively; (*g*) a dike extending from the Pennsylvania shore out and down the river, length 4 600 feet; (*h*) near lower end of Burlington Island, a wing dike, length 1,100 feet; (*i*) between the upper end of Burlington Island and the New Jersey shore, a submerged dike, with top at reference −7, length 500 feet; (*j*) opposite Roebling a dike extending out and downstream from the Pennsylvania shore, length 2,100 feet; (*k*) from Duck Island to New Jersey shore near Bordentown a dike in a broken line with an aggregate length of 5,100 feet.

The total length of dikes deemed necessary is 25,050 linear feet. The cost estimated at $13 per linear foot is $325,650. It is believed that this estimate is sufficient to cover the cost of all dike work required. The exact location, length, and elevation to be given to individual dikes are subject to such changes as may be determined by experience as the work progresses.

The canal section begins at Bordentown and the distances are measured from the center of the bridge of the Trenton and Bordentown branch of the Camden and Amboy division of the Pennsylvania Railroad over Crosswicks Creek near Bordentown.

From station 0+00 to station 6+600 the elevation does not rise above +5. The material is sand and clay and will be Class A and Class B excavation.

	Cubic yards.
Class A	1, 131, 358
Class B	147, 266

From station 6+600 to station 9+300 the canal line passes through a high neck of land of which the maximum elevation is +64. This cut is rendered necessary to avoid a bend in the line so sharp as

to prove an obstruction to navigation. The material of the cut is sand and clay and will be Class A, Class B, and Class C excavation.

	Cubic yards.
Class A	481, 550
Class B	366, 412
Class C	1, 658, 979

From station 9+300 to station 17+100 the elevation is between +5 and +30. The material is sand and clay and will be Class A, Class B, and Class C excavation.

	Cubic yards.
Class A	1, 595, 636
Class B	789, 979
Class C	162, 112

At station 17+100 there is to be an emergency lock and by-pass. This emergency lock is to have an available length of 600 feet, and an available width of 75 feet with a lift of 22 feet. The depth over the miter sills is to be 27 feet at mean low water. Other details are given later in this report.

Excavation for lock and by-pass, Class C, 807,228 cubic yards.

From station 18+100 to station 90+000 the elevation is between +40 and +90 feet. The material is sand and clay and will be Class A, Class B, and Class C excavation. The material can be spoiled on nearby waste land.

	Cubic yards.
Class A	12, 849, 290
Class B	10, 483, 790
Class C	80, 317, 629

From station 90+000 to station 112+000 the elevation is between +70 and +135 feet. The material is sand and clay and will be Class A, Class B, and Class C excavation. The material can be spoiled on nearby waste lands.

	Cubic yards.
Class A	3, 938, 000
Class B	3, 214, 200
Class C	34, 685, 524

From station 112+000 to station 122+600 the elevation is between +30 and +70. The material is all sand with layers of quicksand and will be Class A, Class B, and Class C excavation. This material can be spoiled on nearby waste land.

	Cubic yards.
Class A	1, 779, 700
Class B	1, 453, 800
Class C	2, 927, 133

From station 122+600 to station 153+600 the elevation is between +10 and +25. The material is mostly sand with a few layers of clay and will be Class A, Class B, and Class C excavation. This material can all be deposited directly back of the canal.

	Cubic yards.
Class A	5, 574, 100
Class B	4, 096, 100
Class C	867, 089

From station 153+600 to station 162+300 the canal line passes through the high lands near Cheesequake and reaches an elevation of +88. The material is sand and clay and will be Class A, Class B,

and Class C excavation. This material can be spoiled on Cheesequake Meadows.

	Cubic yards.
Class A	1,512,700
Class B	1,235,500
Class C	2,935,978

From station 162 + 300 to station 164 + 200 the elevation is between + 7 and + 15. The material is sand and clay and will be Class A and Class B excavation. This material can all be pumped in Cheesequake Meadows.

	Cubic yards.
Class A	368,750
Class B	179,604

From station 164 + 200 to station 174 + 600 the elevation is between + 7 and + 25. The material is sand and clay and will be Class A, Class B, and Class C excavation. This material can be spoiled on Cheesequake Meadows.

	Cubic yards.
Class A	68,023
Class B	55,560
Class C	36,260

From station 174 + 600 to station 176 + 000 the elevation is about + 6. The material is all clay and will be Class A and Class B excavation. This material can be spilled on Cheesequake Meadows.

	Cubic yards.
Class A	2,014,990
Class B	604,005

From station 176 + 000 to station 177 + 880, which is the end of the canal section, the elevation is all below zero. The material is mostly clay with a few layers of sand and will be Class A excavation. This material can be spilled on Cheesequake Meadows.

	Cubic yards.
Class A	237,441
Total excavation:	
Class A	31,551,538
Class B	22,626,216
Class C	124,397,932
Total cost of excavation	$31,428,672.60

BRIDGES.

The proposed canal crosses 34 highways of more or less importance, 3 single-track trolley roads, 3 double-track and 1 single-track steam railroads.

As all the bridges across the canal must be drawbridges, it is important that the number be reduced to the minimum that will accommodate the travel satisfactorily. Accordingly, where the highways are near together it is proposed to provide one bridge to serve two or more and to build stretches of connecting roads. All the trolleys are to be carried across the canal on combination highway and trolley bridges. The style of bridge decided upon by the board is the bascule lift type, giving a clear opening of 150 feet. The highway bridges will have a roadway 18 feet wide.

It is desirable that the clear height under the bridges be as great as possible, or at least be sufficient to allow most of the small pleasure craft and tugs with barges to pass through without lifting the draw.

This will not only avoid occasional delays for such boats, but will also lessen the delays to travel over the bridges. In order to accomplish this. a minimum clearance of 24 feet at normal high water has been fixed, which is the minimum allowable clearance on the Harlem River.

The following table shows the railroad, trolley, and highway and highway bridges to be constructed over the canal, also the proposed railroad and highway changes along the route of the canal. (For further information see detail maps.)

Crossing.	Type.	Bridge.	Present angle to normal.	Length of track or road relocation.	Clearance at mean low water.	Remarks.
			Degrees.	*Feet.*		
0+00	Railroad	None.	50			Proposed crossing at station 4+240.
4+240	do	1		10,000	31	Double-track bridge; single-track road.
9+075	Highway and trolley.	1	5	200	64	Camden and Trenton; Yardville-Trenton.
14+650	do	1	60	1,500	31	Proposed bridge at station 14+770.
22+150	Highway, change.	None.	65	6,250		Crossing at station 27+350.
26+550	do	None.	60	1,350		
27+350	Highway	1	5	100	74	
32+700	do	1	10	500	94	
37+850	do	None.	5			No road construction necessary.
44+200	Highway, change.	None.		4,200		Crossing at station 47+600.
44+800						
47+600	Highway	1	20	600	74	
51+600	do	None.	60			No road construction necessary.
55+140	do	1			94	
From 55+140 to 62+450.	Highway, change.	None.	90	7,250		Road constructed on west side of canal.
62+450	Highway	1	5		94	
From 62+450 to 71+400.	Highway, change.	None.	90	6,050		Do.
71+400	Highway	1	10	500	94	
72+700	Highway, change.	None.		2.200		Crossing at station 71+400.
77+800	Highway	1	80	600	74	
From 80+750 to 84+600.	Highway, change.			9,500		Road constructed on east and west side of canal.
89+350	Highway	1	30	700	94	
95+200	Highway, change.	None.	25	3,000		Crossing at station 97+750.
97+750	Highway	1		600	94	
From 99+900 to 104+200.	Highway, change.	None.	60	11,650		Road constructed on both sides of canal.
104+700	Railroad	None.				Proposed crossing at station 109+700 for all Pennsylvania R. R. trains; double track.
109+700	do	1		32,740	110	
109+740	Highway	1			64	
111+500	Highway, change.	None.	10	1,750		
115+950	Railroad	None.	60			Proposed crossing at station 109+700.
116+650	Highway	1	60	1,200	34	
121+950	do	None.	45			No road construction necessary.
130+670	do	1		600	31	
Between 140+000	do			3,800	31	Bridge at station 141+200.
141+200		1				
142+100						Road constructed on east side.
153+650	Highway	1	45	600	31	
160+900	do	1	45	1,000	74	
176+280	Railroad	1	10	7,000	31	Double-track bridge; single-track road.
176+850	Highway and trolley.	1		1,600	31	South Amboy-Keyport.

SUMMARY.

15 highway bridges and 10,300 feet of approach	$1,963,959
57,000 feet new highway construction	51,300
3 combination highway and trolley bridges and relocating of 3,300 feet of trolley and highways	328,034
3 double-track railroad bridges	672,246
7.52 miles of double-track railroad	225,600
1.9 miles of single-track railroad	38,000
Total	3,279,139

SIPHONS.

In order to provide for the discharge of the streams crossing the canal line without interference with their flow, it is proposed to construct inverted siphons at Miry Run, Assinpink Creek, Bear Brook, Millstone River, Cranberry Brook, and Tennents Brook, and to carry the water under the canal. The siphons are to be reenforced concrete construction, composed of 2 separate pipes, each capable of carrying off the storm run-off. Each siphon will be supplied with a valve at a point slightly above the water in the canal and a flush pipe extended beyond the slope line on the west side of the canal, arranged with a valve so that the siphon can be cleaned by the flow of water due to the increased head.

The pipes will follow the side slopes of the canal as nearly as possible, and will be buried to a depth of 5 feet beneath the bottom of the canal. On both sides earth dams will be constructed extending across the valley on the east side at a height of 10 feet and on the west at a height of 5 feet above the bed of the stream. On the east side the dam will form a settling basin and will also act as a catch basin in case of emergency.

A concrete apron 25 feet long will be built in front of the intake, which will also be of concrete construction. The outlet will be of concrete, and a 25-foot apron will be built in front of it. The river bed will be paved for 75 feet.

The following table shows the siphons to be constructed under the canal. (For further information see detail maps.)

Station.	Size of pipe.	Elevation.		Length of—			Remarks.
		Intake.	Outlet.	Siphon.	East dam.	West dam.	
	Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
39+100	24	+72	+69	715	1,200	750	
47+300	42	+74	+70	2,940	1,200	500	
59+350	24	+79	+76	732	2,500	....	West dam will be formed by new highway embankment.
67+600	54	+72	+69	865	1,500	....	Do.
75+350	36	+70	+67	710	1,000	700	
151+300	36	+18	+15	575	2,800	1,000	

SUMMARY.

Miry Run, station 39+100	$10,323.00
Assinpink Creek, station 47+300	21,355.00
Bear Brook, station 59+350	16,877.20
Millstone River, station 67+600	20,062.12
Cranbury Brook, station 75+350	12,222.00
Tennents Brook, station 151+300	22,638.00
Total	103,477.32

SLOPE PROTECTION.

Revetment.—A stone revetment $1\frac{1}{2}$ feet thick, built of 1-man stone, laid by hand, is to be placed on the slopes on both sides of the canal for the entire length of the canal section. It is to extend from -7 feet to $+12$ feet, having a slope length of 42.5 feet. At the foot is to be placed 2 by 12 inch sheet piling, 4 feet long. No revetment is to be placed on either the Delaware River section or the New York Bay section. The cost is estimated at $2,010,980.

EMERGENCY LOCK AND MOVABLE DAM.

In determining the necessity for constructing an emergency lock and movable dam, two factors entered into the consideration. First, the Delaware River freshets; second, the tidal movement in the canal.

A glance at the table on page 58 of freshet heights at Bordentown, N. J., is sufficient to show that it is imperative to put in a lock to keep navigation open at such periods.

Extensive studies and elaborate computations have been made regarding the tidal effect in the canal.

The following tidal data were used in the computations:

	Bordentown.	Morgan
High water lunitidal interval	4 hours 5 minutes	7 hours 40 minutes.
Low water lunitidal interval	11 hours 28 minutes	1 hour 40 minutes.
Mean range of tide	4.8 feet	5.1 feet.
West longitude in hours	4.981	4.951.
Tidal or cotidal hour for high water	VIII.93	XII.36.
Tidal or cotidal hour for low water	IV.06	VI.56.
Tidal or cotidal hour mean semidiurnal wave	IX.5	XII.46.

Through the courtesy of the Superintendent of the United States Coast and Geodetic Survey it is learned that—

the problem of a canal connecting two rather distant tidal bodies has never been solved when resistance proportional to the square of the velocity is taken into account.

The application of the formulas for a long and deep canal where the depth is sufficient to make the frictional resistence of relatively small consequence gives a maximum current velocity of 3.1 miles per hour. The superintendent believes that the conditions in the proposed canal across New Jersey will more nearly approximate the conditions in a short canal where velocities are dependent on the relative tidal heights at the ends, and in that case believes that the maximum velocity will not exceed 1.27 miles per hour. The formula given on page 58, deduced from known data in certain rivers as stated, makes the rate of propagation of a tidal wave through the canal about 13.4 miles per hour, and based on this the calculations of this office were made. The maximum current velocity in the canal generated by the tidal wave is computed to be 1.86 feet per second or 1.27 miles per hour. It is computed that there will be an excess tidal flow of 32,254,334 cubic feet to the north each 12 hours and that the resultant movement of a particle of water in one tidal cycle will be north 5,812 feet. From the above it appears that very little, if any, salt water will reach the Delaware River and that the maximum current velocity will not be great enough to necessitate the use of the

lock and movable dam except in case of freshets in the Delaware River.

The lock is to be constructed between stations 17+100 and 18+100. It is to have a usable length of 600 feet, a width of 75 feet, a lift of 22 feet, and a depth on the miter sill of 25 feet at lowest low water. The tops of the walls are to be at elevation +25 and the walls are to be of 1:3:5 concrete. A guide wall, composed of 1:3:5 concrete piers, spaced 10 feet apart, connected at the top by reenforced concrete slabs, extends a distance of 600 feet at both ends of the lock. The main culvert, 15 feet in diameter, extends from the forebay to the tailbay through the entire length of the two walls. The water is to be conveyed to the lock chamber by means of branch culverts, 7 feet in diameter, spaced 30 feet apart, with opening sufficient to furnish a rise of water in the lock chamber of 5 feet per minute. The supply of water in the main culverts is to be controlled by 4 Stoney valves, 2 in each wall, and that in the branch culverts by 18 cylindrical seat valves. Owing to the absence of rock formation at the site, the floor girders must be of sufficient depth and strength to contain the culverts and provide a footing for the walls. The floor slabs, which contain the branch culverts and furnish a foot for the wall, are to be of reenforced concrete construction. Two sets of miter gates, similar to those adopted on the Panama Canal, operating in opposite directions, will be provided at the north end of the lock. At the south end a rolling gate, of the type used on the Ohio River, will be provided. A recess for a set of miter gates will be left at the south end of the lock in case it is found advisable to install them. The supply of water being ample, no intermediate gates are required. The elevation of the top of the gate is +22. The estimated cost of the lock complete is $1,488,229.10.

In order not to increase the velocity of the water in the canal at the lock site, a movable dam is to be placed on the east side of the lock at the southern quoin section. It is to be of the rolling-gate type, similiar to the lock gates used on the Ohio River. The west recess for the closure of the gate dam will be constructed in the southern quoin section of the east wall of the lock. There is to be a clear waterway between the east lock wall and the east gate recess of 106 feet. The sill is to be of reenforced concrete construction and to have a depth on it of 25 feet at lowest low water. The east gate recess walls are to be of reenforced concrete construction. The gate dam will be operated on rollers running on a track and will be provided with butterfly valves, which will be kept open while it is being placed in position. The top of the gate dam is to be at elevation +22.

FENCING.

The canal will be inclosed on both sides by a fence extending from tidewater in the Delaware River to tidewater in New York Bay. The cost is estimated at $17,856.

LIGHTING.

The waterway will be lighted along its entire length through the New Jersey land section. Arc lights will be placed along the canal at intervals of 1,000 feet. The cost of erecting power house and installing the lighting system is estimated at $100,200.

TELEPHONES.

A telephone system 34 miles long, with 30 telephones, will be installed for the entire length of the land section of the canal. The cost is estimated at $25,000.

MECHANICAL INSTALLATION.

The boilers, engines, generators, and motors for generating the power to operate the lock and bridges will be placed in the same power house as that erected for lighting purposes. A 1,500 horsepower plant will be installed. In this item is also included the transmission line to the lock and bridges, the operating machinery for the lock gates and movable dam, and the unwatering pumps at lock. The cost is estimated at $95,000.

JETTIES.

At the mouth of Cheesequake Creek two stone jetties will be constructed, 1,050 feet long, to protect the entrance to the canal. The cost is estimated at $75,600.

RIGHT OF WAY.

By a recent joint resolution of the two houses of the New Jersey Legislature, the State of New Jersey pledges itself to appropriate $500,000 for the purchase of the necessary right of way through New Jersey for the intracoastal waterway, the above amount, or a portion thereof, to become available as soon as the Federal Government is ready to start construction. It is estimated that this amount will be sufficient to purchase the necessary right of way, but not sufficient to cover the water-power damages.

SPOIL BANKS.

Along the entire route of the canal are found tracts of land now unused on account of various conditions. In general such lands would be improved and made available for useful purposes by the deposit on them of spoil from the canal cut. While such is the case, experience elsewhere has shown that owners of such lands are at times disposed to demand a heavy price for the use of their lands as deposits for spoil. Under these conditions it is deemed best to include in the estimates a sum for the purchase of lands for spoil banks and for securing rights of way thereto. The estimated cost of the lands necessary for this purpose is $419,474.60. Later, when no longer needed, it is believed that these lands can be sold at an advanced price.

WATER-POWER DAMAGES.

The water powers affected by the construction of the New Jersey section of the intracoastal waterway will be the Bordentown pumping station; Cropp's feed mill, Hutchinson mill pond; Physical Culture Publishing Co., Outcault, N. J.; De Voes Snuff Mills, at Spotswood; Bloomfield Licorice Mill; Greystone Wood Works; pumping station

of the South River Water Co.; and the Runyon pumping station, which supplies South Amboy, Perth Amboy, and Old Bridge.

(*a*) *Bordentown pumping station.*—This pumping station is located 1,800 feet northwest of the line, and pumps the water from a well located near the station through a 10-foot pipe to a standpipe in Bordentown. It has a capacity of 1,000,000 gallons per 24 hours. It is not thought that the construction of the canal will materially affect the supply of water, as most of the wells are below −20. Should any of the wells be disturbed they can be relocated at little expense.

(*b*) *Cropp's feed mill, Hutchinson millpond.*—The construction of a canal will go through this mill, which is a 2-story frame structure, 80 by 50 feet. At present this mill is equipped with one 22-inch hydraulic turbine, developing 40 horsepower under a 16-foot head and has a capacity of 45 barrels of flour per day.

It is proposed to lift this mill off its foundation and move it west 1,500 feet, then to restore it to its original condition and substitute for the water power a steam auxiliary.

At present the mill is not running, and has not run for a number of years, but the estimate of damages is based on its running 100 days out of the year and 10 hours per day.

The property on which the mill is to be placed after it has been moved is owned by Mr. Cropp, the present owner of the mill.

(*c*) *Helmetta snuff mill, Helmetta, N. J.*, owned by the American Snuff Co. This mill is located 1,000 feet west of the canal line, on the east side of the Camden & Amboy Railroad, 1,000 feet northeast of Helmetta, and in a brick building 80 by 40 feet. It is equipped with one 28-inch turbine, developing 20 horsepower, under an 11-foot head. It runs 250 days of 10 hours each per year. It has an efficiency of 75 per cent. This turbine is fed by two small streams, one having its origin just north of Helmetta, the flow of which becomes very small in extreme dry weather; the other stream has its origin north of Jamesburg, and flows through the cranberry bog, joining the first stream near Helmetta. This latter stream is fed by springs, and has a fairly uniform but small flow most of the time, and will be shut off as a source of supply to the turbine by the canal crossing it in several places.

It is estimated that the flow of the first stream will be sufficient the greater part of the time to supply more than the power now being developed, namely, 20 horsepower under an 11-foot head.

Inasmuch as the mill is at present equipped with steam auxiliary and the percentage of the time which the turbine would have to be shut down owing to lack of water is so small, no damages should be awarded the American Snuff Co., so none have been included in this estimate.

(*d*) At Outcault Lake there is a dam which has a fall of 6.6 feet over which 74 cubic feet of water is passing per second. At this site on the right of way, but 100 feet from the slope line of the canal, is situated the power house for the old publishing house of the Physical Culture Magazine. There are two wooden buildings, 200 feet by 80 feet and 70 feet by 40 feet, respectively. In this power house are two turbines, one 6 feet in diameter, developing 20 horsepower under 6.6-foot head, and one 5 feet in diameter, developing 25 horsepower under 6.6-foot head.

The 5-foot wheel was installed in 1865 and the 6-foot wheel in 1869. The power house is also equipped with one 50-horsepower vertical fire tube boiler; one 25 horsepower and one 15 horsepower vertical engine; one 6 horsepower gas motor; and one 292 revolutions per minute, 75-ampere, 125-volt generator for lighting purposes.

It is proposed to leave the buildings on the present site.

The steam auxiliary being installed, the only damages which they could claim would be the amount of capital which at 4 per cent would give the operating expenses to develop 40 horsepower, running 300 days of 10 hours each.

(*e*) *De Voes Snuff Co. snuff mill*, owned by American Snuff Co., located at Spotswood. This mill is located about 500 feet from the center line of the canal, and is a brick building 60 by 50 feet.

The fall by which the power is generated is obtained by damming up Manalapan Brook, making an artificial pond. The canal line runs directly through this pond and will obliterate same.

The mill has two 36-inch wheels operating under an 8-foot head, each wheel having a capacity of 25 horsepower, making a total of 50 horsepower developed. The mill is also equipped with one 40-horsepower boiler, one 30-horsepower engine, and one 10-horsepower engine, and one 10-horsepower dynamo.

The steam auxiliary being installed the only damages which they could claim would be the amount of capital which at 4 per cent would give the operating expenses to develop 40 horsepower, running 300 days of 10 hours each.

(*f*) *Bloomfield licorice mill*, 1,200 feet south of East Spotswood railroad station on Manalapan Brook. This mill is located about 800 feet west of the center line of the canal, but some of the storehouses are inside the right of way. The mill is a wooden building, 90 by 40 feet. There are two turbines (sizes not known) which, under a 7-foot head, develop 80 horsepower.

There is no steam auxiliary installed in this mill at present. It will therefore be necessary to furnish them with one 80-horsepower boiler and one 80-horsepower engine.

It is claimed that this mill runs night and day for 7 months in the year and 10 hours a day for the remaining 5 months.

(*g*) *Greystone woodworks*, located on the Matchaponix Brook, about 2,500 feet east of the center line of the canal.

The Matchaponix Brook draining as it does from the east, the water power at this mill will not be disturbed.

(*h*) *Pumping station of the South River Water Co.*, located on the South River. This pumping station is about 1,000 feet west of the canal line, and is on the South River, from which it pumps its water. This river will enter the canal near Helmetta, thus obliterating the river at this point. This pumping station is a brick building 20 by 20 feet.

There is one 10-horsepower gas engine and one triplex pump 7 by 8 inches, Gould Manufacturing Co., Seneca Falls, N. Y.

This pumping station can be moved to a site on the Matchaponix Brook and the pipes carried under the canal, and thence to a point where they will join the old pipe, a distance of approximately 8,000 feet.

(*i*) *Pumping station of Perth Amboy waterworks*, located 1,000 feet southeast of Runyon station. This pumping station is fed by a series

of wells connected by pipes which extend over 5,000 feet from the pumping station. These buildings are both brick. The canal has been located so that the nearest point to these wells is 1,400 feet.

These wells are at an elevation of from −10 feet to −40 feet, and they will probably be very little affected by the construction of the canal.

An embankment will be placed on the west side of the canal across the pond into which Tennent Brook enters, and the brook will be siphoned under the canal, thus very little affecting the storage capacity of the pond.

The estimated cost for this work is included in the estimate for the Tennent Brook siphon.

Summary of water-power damages.

Total.. $101,800

LOWERING OF GROUND WATER.

The clay and sand deposits found along the line of the canal are irregular in shape and in pitch. It is impossible to foretell with accuracy to what extent or distance the ground water may be lowered by the construction of the canal. In many places where the clay deposits are near the surface there will probably be no lowering. Due to the very steep slope required for ground-water flow through compact soils and the low rate of flow it is improbable that damage due to the lowering of the ground water will be great.

NEW YORK BAY SECTION.

The New York Bay channel is to be of the same size and to have the same cross section as the Delaware River Channel. It will run from station 177+880 (canal stationing) in a general northeasterly direction to deep water, following, wherever possible, the present channel line. The distance from the entrance to the canal to deep water will be about 12.1 miles. The dredging will all be Class A excavation and will amount to 1,955,350 cubic yards.

WATER POWER AVAILABLE.

At station 117+350 the Manalapan Brook will enter the canal. The elevation of the stream bed is +25 feet. By constructing a dam 1,500 feet long the elevation of the water can be raised to 33 feet. The flow of this stream will be not less than 70 cubic feet per second for 80 per cent of the year. With a fall of 30 feet and a flow of 70 cubic feet per second the power developed would be 190 horsepower. It is proposed to erect the power house for lighting and operating the machinery equipment of the canal at this point, and to utilize all the water available for power purposes. The cost of this is included in the item for lighting.

At station 132+600 the Matchaponix Brook will enter the canal. The elevation of the stream bed is +12 feet. By constructing a dam 1,950 feet long the elevation of the water can be raised to 20 feet. The flow of this stream will be not less than 20 cubic feet per second for 70 per cent of the year; the remaining 30 per cent of the year the stream will be dry. With a fall of 20 feet and a flow of 20 cubic feet per second, the power developed would be 36 horsepower, which would not pay for the construction of a plant.

MAINTENANCE AND OPERATION.

Dredging.—It is believed that the channel depths between Philadelphia and New York can be maintained by not more than two moderate-powered dredges. These with their auxiliary plant can be operated at a cost of $155,000 per year.

Bridges.—The cost of maintenance of the bridges is estimated at 3 per cent of the first cost of the superstructure. The cost of operating the bridges is difficult to estimate. Of the 21 bridges proposed, 7 have a mean low water clearance of 31 feet, 1 of 34 feet, 2 of 64 feet, 4 of 74 feet, 6 of 94 feet, and 1 of 110 feet.

The following table shows various types of vessels for which draw spans will have to be opened:

Type of vessels.	Height of mast above water line.	Tonnage.	Draft.	Remarks.
	Feet.		*Feet.*	
Converted barges	100–125	1,500–5,000	13–24	
Passenger and freight steamer	80–100	200–3,000	10–15	
Seagoing tugs	90		15–17	
Average harbor tug	50		10	
Harlem River tug	24		10	
Average tramp steamer	90	5,000–5,500	22–25	
Schooner, 3-mast	145			Top of mast can be lowered 30 to 40 feet.
Schooner, 4-mast	160–170			Top of mast can be lowered 30 to 50 feet.

The cost of maintenance and operation is estimated at $73,545.

Lock gates and movable dam.—As the gates and movable dam will be operated only for a few days out of the year, the cost of operation will be very small, and it is thought that 5 per cent of the cost of the steel in the lock gates and the movable dam will be ample for cost of maintenance and operation. Estimated cost, $17,672.

Slopes and embankments.—It is estimated that labor at the rate of at least one man per mile will have to be employed in the care of slopes, embankments, fences, and siphons. The care of the highways should be assumed by the State, since they will replace existing State roads. The estimated annual cost of this labor is $20,000.

Lighting and power plant.—The estimated cost of maintenance and operation of these two items is $16,000.

Superintendence and police.—The estimated annual cost of this item is $30,000.

Summary of maintenance costs.

Dredging	$155,000
Bridges	73,545
Lock gates and movable dam	17,672
Slopes and embankments	20,000
Lighting and power plant	16,000
Superintendence and police	30,000
Total	312,217

SPEED OF BOATS IN CANALS.

In the Delaware River section and the New York Bay section the speed attained will be about 20 per cent less than that in the open sea.

In the inland section the allowable speed of boats will vary according to the ratio of the sectional area of the boat to the sectional area of the canal.

The following table was compiled by the use of Herr Hoack's formulæ $V = \frac{\triangle Q + q}{Q - \triangle Q - q} D$, which was derived from experiments made by him, in which V = velocity of back flow = maximum 3 feet per second. $\triangle Q$ = the cross section between the sunken surface, due to the boat's motion, and the normal water surface = 112 square feet in size of canal under consideration.

q = the mean cross section of the boat.

Q = the wet cross section of the canal.

D = the velocity of the boat.

This table shows the allowable speed for various sized boats. Maximum speed permitted for small boats 12 miles per hour.

Sectional area of canal at mean low water.	Sectional area of boat.	Ratio.	Allowable speed, miles per hour.	Class of boats.	Depth.	Breadth.	Tonnage.
[1] 4,375	154	1:28.4	10	Tugs, canal boats, yachts	8	20	....
[1] 4,375	264	1:16.6	10	.....do	10.5	26.3	....
[1] 4,375	490	1:8.9	10	Freight	15	34	Net.
[2] 4,375	790	1:5.5	7.8	.....do	16	52	3,000
4,375	864	1:5	7.1	.....do	18	50	....
4,375	1,136	1:3.8	5.1	....	23	52	4,000

[1] These determinations agree closely with those made for the Panama Canal.
[2] Running between Baltimore and Wilmington.

The speed permitted in the Amsterdam Canal, which has a cross section of 4,000 square feet, is 5.6 miles per hour for boats having a net section of 880 square feet.

Kiel Canal.—The area of the cross section is about 4,100 square feet. The speed permitted is 6.2 miles per hour. The chief engineer states that the largest ships make only 4.6 miles per hour.

Manchester Canal.—The area of cross section is about 4,100 square feet. The limit of speed permitted is 6.2 miles per hour for the largest ships using the canal. The largest ships are towed through the canal. The banks are generally firm clay. Smaller boats are allowed greater speed up to 13 miles per hour. At these high speeds much damage is done to the slopes near the water line.

Suez Canal.—The area of the cross section before enlargement was about 3,700 square feet. The highest speed allowed in the canal for large boats was 5.75 miles per hour. The soil is sand and easily moved, and the cost of maintenance has always been great.

Assuming that a boat having a submerged sectional area of about 800 square feet and a net tonnage of between 2,000 and 3,000 tons will be the type of boat generally using the proposed canal, the allowable speed for such a boat through the canal will be about 8 miles per hour.

WIDENING CANAL SECTION ON CURVES.

Studies were made of the subject of increased width necessary for curved sections in canal construction, and suitable provisions were made therefor. (See Appendix C 1, p. 160.)

AVAILABLE STONE SUPPLY.

The nearest available stone for concrete and stone revetment is at the Rocky Hill quarries. The stone at these quarries is a very good trap rock. It can be delivered to the canal line at the intersection of the Monmouth division of the Pennsylvania Railroad with a haul of about 10 miles.

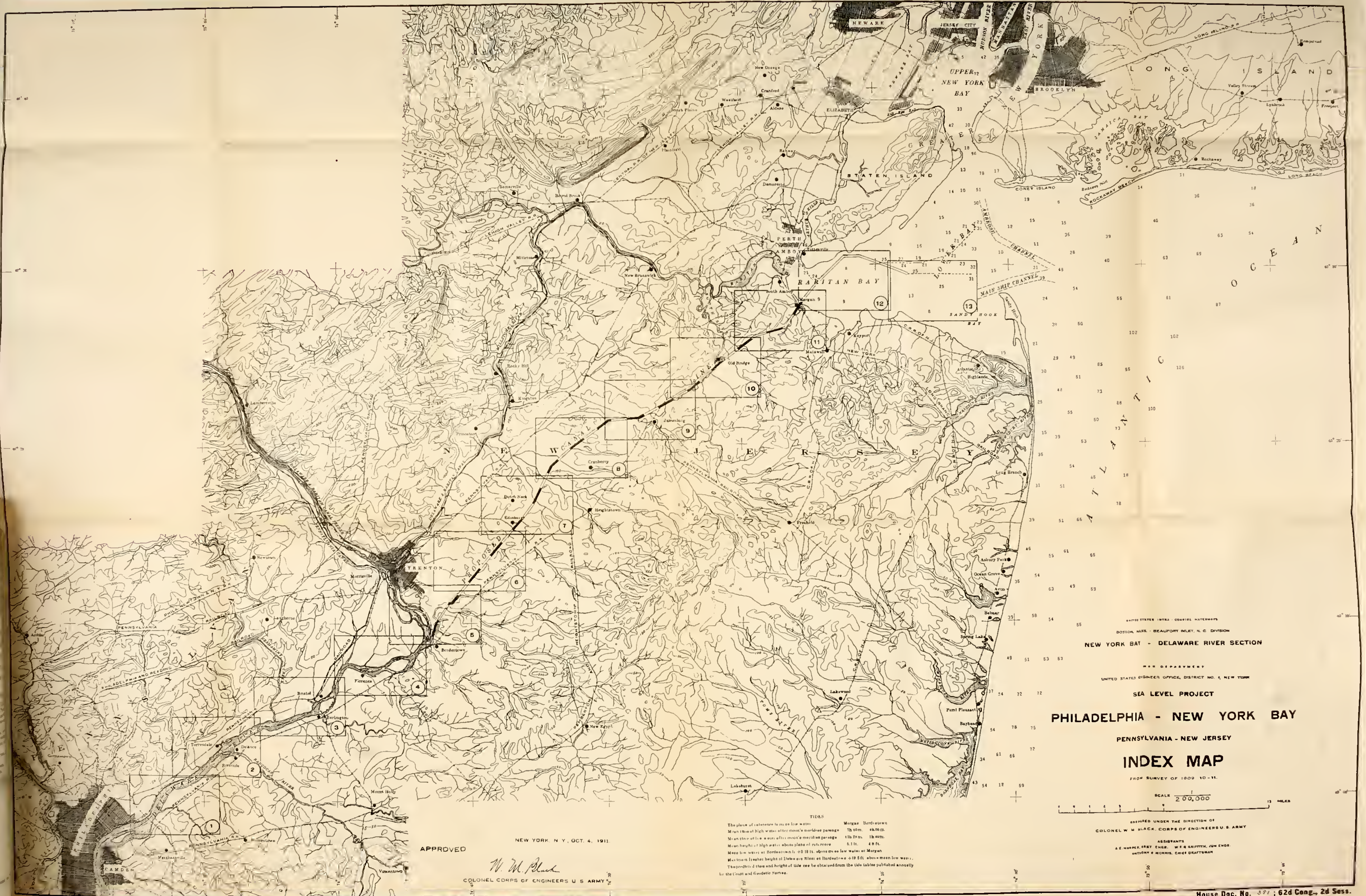
MAPS.

A general index map on a scale of 1:150,000 and 14 sheets[1] of detail drawings of the route on a scale of 1:10,000 are herewith submitted. Tables of data concerning the survey are printed on the maps.

SUMMARY OF CANAL STATISTICS.

Distance from deep water in Delaware River to deep water in New York Bay, 75.7 miles.
Distance from deep water in Delaware River to Bordentown, N. J., 26 miles.
Distance from Bordentown to Lalor Street, Trenton, N. J., 3.9 miles.
Distance from Bordentown to Morgan, N. J., across New Jersey, 33.7 miles.
Distance from Morgan to deep water in New York Bay, 12.1 miles.
Distance from wharves in Philadelphia to the Battery in New York City (via canal), about 87 miles.
Distance from wharves in Philadelphia to the Battery in New York City (via outside route), about 274 miles.
Speed in the canal, 8 miles per hour.
Speed in Delaware River and New York Bay for largest ships, about 20 per cent less than in open sea.
Assuming that the speed of the largest boat using the canal would be about 15 miles per hour in the open sea, the time of transit from the wharves at Philadelphia to the Battery in New York City (via canal) would be about 8 hours and 40 minutes; between the same points (via outside route), about 20 hours, or twice as long as it would take via canal.
Size of canal section: Bottom width, 125 feet; depth, 25 feet at lowest low water.
Size of Delaware River and New York Bay section: 100 feet bottom width; depth, 25 feet at lowest low water, and 300 feet bottom width; depth, 18 feet at lowest low water.
Maximum deflection in any single intersection angle on canal section, 36 degrees, 51 minutes, 15.3 seconds.
Total deflection on canal section, 246 degrees, 26 minutes, 58.4 seconds.
Resultant deflection to the east, 13 degrees, 39 minutes, 49.4 seconds.
Number of locks, 1.
Number of movable dams, 1.
Usable length of lock, 600 feet.
Usable width of lock, 75 feet.
Depth on miter sill at lowest low water, 25 feet.
Number of railroad draw spans, 3.
Number of combination trolley and highway, 3.
Number of highway draw spans, 15.
Number of siphons, 6.
Number of miles of double-track railroad construction, 7.52.
Number of miles of single-track railroad construction, 1.9.
Number of feet of trolley construction, 3,300.
Number of feet of highway construction, 57,000.
Class A excavation (below zero), 33,506,888 cubic yards.
Class B excavation (zero to +15.0), 22,626,216 cubic yards.
Class C excavation (above +15.0), 124,397,932 cubic yards.
Class D excavation, 5,654,000 cubic yards.
Length of dikes on Delaware River, 25,050 lineal feet.
Slope protection, 821,628 cubic yards.
Sheet piling for slope protection footing, 2,784, quantity in thousand feet B. M.
All azimuths are reckoned from the south.
General index map scale, 1:150,000.
Detail maps scale, 1:10,000.
Survey data shown on detail sheets.

[1] Not printed.



House Doc. No. 391; 62d Cong., 2d Sess.

The following table gives the unit prices which were used in figuring this estimate:

Article.	Unit.	Cost.	Remarks.
Excavation:			
Class A	Cubic yard	$0.10	Excavation from elevation 00 to bottom.
Class B	do	.15	Excavation from elevation 00 to +15.
Class C	do	.20	Excavation from elevation +15 up.
Class D	do	.20	Delaware River dredging.
All concrete	do	6.75	1:3:5 40 per cent voids in stone.
Railroad:			
Double track	Miles	30,000.00	
Single track	do	20,000.00	
Trolley	do	16,000.00	
Highway	Foot	.90	All necessary items.
Slope protection:			
Stone	Cubic yard	2.313	Laid.
Lumber	B. M.	40.00	Sheet piles driven.
Steel	Pound	.05	Structural and reenforcement in place.
Dikes	Linear foot	13.00	Delaware River.
Railroad draw spans	Each	90,000.00	Superstructure and operating machinery.
Trolley and highway draw spans.	do	52,000.00	Do.
Highway draw span	do	34,000.00	Do.
Jetty stone	Ton	1.00	

Detailed estimate of cost.

Items.	Quantity.	Unit price.	Cost.	Remarks.
Water-power damages	5 power stations		$101,800.00	
Excavation:				
Class A	33,506,888 cubic yards.	$0.10 per cubic yard.	3,350,688.80	Below zero.
Class B	22,626,216 cubic yards.	$0.15 per cubic yard.	3,393,932.40	Zero to +15.0.
Class C	124,397,932 cubic yards.	$0.20 per cubic yard.	24,879,586.40	Above +15.0.
Bridges, railroad	3	$90,000	672,246.00	Unit price for superstructure.
Bridges, trolley and highway.	3	$52,000	328,034.00	Unit price for superstructure. Cost includes 3,300 feet of trolley and highway change.
Bridges, highway	15	$34,000	1,963,959.00	Unit price for superstructure. Cost includes highway approaches.
Siphons	6		103,477.32	
Railroad change	7.52 miles	$30,000 per mile	225,600.00	Double track.
Do	1.9 miles	$20,000 per mile	38,000.00	Single track.
Lock	1	Concrete, at $6.75 per cubic yard; steel, $0.05 per pound.	1,488,229.10	
Movable dam	1		100,668.77	
Power-house installation.			95,000.00	
Road construction	57,000 linear feet	$0.90 per foot	51,300.00	
Slope protection	2,784 thousand b. m.	$40 thousand b. m.		Sheet piling driven, stone laid.
	821,628 cubic yards	$2.313 per cubic yard.	2,010,980.00	
Lighting			100,200.00	
Telephone line			25,000.00	
Fence line			17,856.00	
Jetties	75,600 tons stone	$1 per ton	75,600.00	
Estimated cost of spoil banks.			391,438.60	
Total estimated cost of New Jersey land section and New York Bay section.			39,311,796.29	

Detailed estimate of cost—Continued.

Items.	Quantity.	Unit price.	Cost.	Remarks.
Delaware River:				
Philadelphia-Bordentown.	4,650,000 cubic yards.	$0.20 per cubic yard.	$930,000.00	
Bordentown-Trenton.	1,004,000 cubic yards.	$0.20 per cubic yard.	200,800.00	
Dikes	25,050 linear feet	$13 per linear foot	325,650.00	
Estimated cost of spoil banks.			28,036.00	
Total estimated cost of Delaware River section.			1,484,486.00	

New Jersey land section and New York Bay section	$39,311,796.29
Delaware River section	1,484,486.00
	40,796,282.29
Plus for engineering and contingencies	4,203,717.71
Total estimated cost of construction	45,000,000.00

Annual maintenance.

Dredging	$155,000.00
Bridges	73,545.00
Lock gates and movable dam	17,672.00
Slopes and embankment	20,000.00
Lighting and power plant	16,000.00
Superintendence and police	30,000.00
Total annual maintenance	312,217.00
Total estimated cost of construction	45,000,000.00

ECONOMIC CONSIDERATIONS.

The section of the proposed intracoastal waterway between Boston and Beaufort Inlet, which unites by a sheltered waterway across New Jersey the deep waters of New York Harbor with those of the Delaware River, will, if constructed, be an additional path for commerce between two of the greatest centers of population and manufactures of the United States, and will, in addition, unite existing systems of sheltered waterways to the south of Philadelphia and north of Beaufort Inlet with a length of 2,700 miles, to a system to the north of New York City, which, within an area limited on the east by Narragansett Bay, on the west by the Great Lakes, and on the north by Lake Champlain, has a length of 1,156 miles. In the southern system the improvement of the canals south from Norfolk to Beaufort Inlet and from the Delaware to the Chesapeake is now under consideration. The continuation of the Intracoastal Canal south of Beaufort Inlet will bring into connection a further length of 16,800 miles of navigable waterway. In the northern system, the Great Lakes and their tributaries and the improvement of the Canadian canals between Lake Champlain and the St. Lawrence, now under serious consideration, will again add to the mileage of the connected waterways by 2,300 miles. To the east, even should the canal between Narragansett Bay and Boston be not constructed, the opening of the Cape Cod Canal will again extend navigation, with greatly diminished risks, to the entire New England coast.

The extent of the commerce by rail and water through the vast areas thus connected is bewildering in its magnitude as shown by the tables of Appendix C 2, page 162.

The totals of these tables are as follows:

In the following tables the various parts of the United States north of Beaufort, N. C., tributary to the proposed intracoastal waterway are denominated as sections 1, 2, 3, and 4, as follows:

Section 1. New York, New Jersey, Pennsylvania, and Delaware.

Section 2. Area south of section 1 as far as Beaufort, N. C.

Section 3. Northeast of section 1 as far as Boston.

Section 4. North and west of section 1, to Lake Champlain and to the Great Lakes. In lengths of navigable waterways, those of the Great Lakes, of Lake Champlain, and of the St. Lawrence River are included in this section.

Sheltered waterways tributary to the Boston to Beaufort division of the intracoastal waterway project.

	Navigable length in miles.	Tonnage (short tons).	Value of tonnage.
Section 1	464.00	68,831,894	$2,434,233,482
Section 2	2,135.75	29,611,391	427,122,161
Section 3	382.00	19,793,839	527,654,562
Section 4	2,998.00	6,795,331	303,716,241
Total	5,979.75	125,032,455	3,692,726,446

Tonnage and valuation chiefly from Report of Chief of Engineers, United States Army, for 1910.

Summary of principal cities and towns tributary to the Boston to Beaufort division of the intracoastal waterway project.

	Population.	Wage earners.	Number of manufacturing plants.	Capital involved in thousands of dollars.	Cost of materials in thousands of dollars.	Value of products in thousands of dollars.
Section 1	7,617,901	865,954	31,958	2,047,092	1,472,460	2,641,917
Section 2	1,140,548	97,304	3,150	231,610	112,086	217,561
Section 3	1,311,221	180,460	4,681	374,977	231,608	430,467
Section 4	1,355,608	1,605,840	13,917	306,381	191,043	371,890
Total	11,425,278	2,749,558	53,706	2,960,060	2,007,197	3,661,835

Population from census of 1910; statistics from manufacturing census of 1904.

It is difficult to foretell how much of this commerce would actually use the canal across New Jersey. Yet it is only by some estimate of this that a determination can be reached as to whether the gain to be effected to the people of the United States by the construction of the canal would be commensurate with its cost. In order to obtain information as to the necessity for a canal across New Jersey, as well as to the type and depth desired by the commercial interests, letters were sent to representative commercial bodies of the cities and to individual manufacturers along the proposed line. Many responses were received, some of which are appended, the most elaborate and valuable being the Report of the Committee on Traffic of the Proposed Intracoastal Canal Connecting New York and Delaware Bays. This committee was appointed in November, 1910, by the president of the Atlantic Deeper Waterways Association at the request of a citizens' committee of 60, consisting of men from New

York, New Jersey, Pennsylvania, and Delaware. A copy of the report is herewith appended and attention to it is respectfully invited. (See Appendix C 3, p. 175.)

The general opinion expressed by the commercial bodies replying was that a canal is a commercial necessity; that the canal should be of the sea-level type if practicable, and should have a cross section adequate for navigation by vessels of from 2,000 to 3,000 tons capacity at a rate of from 6 to 10 miles per hour.

The State of New Jersey further expressed its interest in the subject by a resolution of its legislature (see Appendix C 4, p. 226) authorizing an expenditure of not to exceed $500,000 to provide the necessary right of way for a canal, and authorizing the governor of New Jersey to appoint a commission to cooperate with the authorities of the United States in the matter.

The movement of commerce to-day parallel to the canal lines is by three thoroughly equipped railroad lines, by the outside sea route between New York and Philadelphia and by the Delaware and Raritan Canal, now obsolescent on account of a restricted cross section and other causes.

For a canal to be necessary, it must be shown that the existing lines of communication are inadequate, or that they are unduly expensive in time or cost of transportation.

ADEQUACY OF EXISTING LINES OF COMMUNICATION.

The total tonnage moved annually by rail across New Jersey is approximately 53,901,000 tons. To move this tonnage the railroads are taxed practically to their full capacity. Delays at the terminals, at the shipping and receiving cities, are frequent, and in years of prosperity when the maximum movement of freight occurs, the railroad service is confessedly unable to handle the traffic promptly. So great is the congestion that one of the lines is contemplating the construction of a new four-track freight line to parallel the existing line in New Jersey through a distance of 45 miles.

The following rough comparison between the cost of increasing the transportation facilities between New York and Philadelphia by rail and by a sheltered waterway may be of interest:

Double-track railroad freight line capacity 168,750 tons per day each way.

Minimum headway for economic operation 75 trains per day each way.

Speed between 16 and 20 miles per hour.

Length of a freight train about 45 cars, each of 50 tons capacity, or a total of 2,250 tons.

The first cost of 1 mile of double-track railroad of modern construction, including bridges, through this thickly populated rolling country is between $75,000 and $100,000.

The cost of 1 mile of the water route between New York and Philadelphia is approximately $493,000.

The capacity of the double-track railroad one way would be 168,750 tons per day. With vessels of 3,000 tons capacity spaced 5 to the mile and running at 6 miles per hour, the freight movement by canal one way would be 2,160,000 tons per day. At these figures the ratio of cost and capacity of a double-track railroad to a canal

of the proposed type are: Cost, about 1 to 5.6; capacity, about 1 to 12.8.

In this connection it might be well to invite attention to the dependence of a great city on its supply lines for the necessities of its daily life, in food and in raw materials. Any disturbance of the regularity of the supply causes immediate suffering and loss. Examples of this may be cited in the United States at the time of the anthracite coal strikes. Another example was afforded by the conditions in Paris within the past year and in England at a more recent date. The more varied in character the lines of supply the less will be the probability of these lines being affected simultaneously by any one cause of disturbance, physical, commercial, or political.

The outside water route between New York and Philadelphia has a capacity for traffic which, with adequate terminal arrangements, is practically unlimited. This route is, however, usable only by vessels of an expensive type of construction, fit for navigation during storms along a lee shore. During the winter season, especially, this route is dangerous. According to the reports of the United States Life-Saving Service, in the single decade, 1900–1909, inclusive, there were on our Atlantic seaboard nearly 5,500 disasters to shipping, involving a loss of over 2,000 human lives and a total vessel and cargo loss of $38,800,000.

In actual practice, although the speed attained by railroad freight trains is much greater than that of water freight carriers, in the time required for the movement of heavy freight from the shipper to the consumer, the advantage lies with the water carrier. At present, delays of two days to a week are frequent in the delivery of goods transported by rail between New York, Trenton, and Philadelphia. By the outside route the time of passage between New York and Philadelphia is from 20 to 30 hours, but delays by storm or fog of much greater duration are frequent through the year. The estimated time of passage through an adequate canal is about 8½ hours. The risk of delay by storms is nil; delays by fog would be infrequent.

The freight rates between New York and Philadelphia via railroad, via outside route, and via Delaware & Raritan Canal, are shown in the following table: [1]

	Class of freight.					
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.
Rate via railroad per 2,000 pounds	$4.40	$3.60	$3.00	$2.40	$2.10	$1.90
Rate via outside route per 2,000 pounds	3.70	2.90	2.50	2.00	1.80	1.60
Rate via Delaware & Raritan Canal [1]					1.80	1.60

[1] The freight rate includes canal tolls.

It is estimated that, with adequate terminal facilities, the freight rate through the proposed Intracoastal Waterway between New York and Philadelphia, in barges of 1,000 ton capacity, loaded 75 per cent, will be 70 cents per ton, and that in barges of 2,000 ton capacity, loaded 60 per cent, the rate will be 60 cents per ton, and the time of transit between New York and Philadelphia will be approximately 10 hours.[2]

[1] P. 222, Philadelphia report. For further details attention is invited to that report.
[2] Appendix C 3.

There are to-day 750,000 tons of freight carried annually by regular line steamers between New York and Philadelphia by the outside route and 400,000 tons by the Delaware & Raritan Canal.

All of this tonnage would probably use the new canal. Two 2,000-ton barges running each way daily would carry an equivalent tonnage.

The cheapest freight rate between New York and Philadelphia by water is $1.60. Taking this rate and the estimated rate of a 2,000-ton barge at 60 cents per ton through the canal, there will be an estimated saving of $1 per ton, or $1,150,000 on 1,150,000 tons.

There are 450,000 tons of freight shipped between Philadelphia and Boston and 200,000 tons between Philadelphia and Providence. These shipments are all made by regular lines via the outside route. The saving in freight by using the canal will be approximately $1 per ton or $650,000 on 650,000 tons.

In discussing the relative freight rates of water transportation and rail transportation, three separate conditions must be taken into consideration. The first, the relative cost of transportation of railroad freight delivered over private sidings and of barge freight which requires no cartage at the terminals. This covers a very considerable proportion of both rail and water shipments. For example, the Pennsylvania Railroad has approximately 360 sidings in Philadelphia, the Philadelphia & Reading 350, and the Baltimore & Ohio 100.[1] But, on the other hand, there are many industrial wharves in Philaphia at which cargoes are shipped and discharged directly. On such shipments the cost of shipping by barge is materially lower than by rail, and is estimated at from $1 to $1.20 per ton less.

The second condition exists as between rail and barge shipments when both of them require cartage at the terminals. Though there are over 800 railroad sidings in Philadelphia, the United States Census Office in 1905 reported over 7,000 manufacturing establishments. Essential parts of every railroad station and water terminal are regular receiving and delivery platforms, warehouses, and team tracks for direct loading and unloading between carrier and trucks. There is sufficient hauling in Philadelphia to support a large public cartage business. There are approximately 5,000 teams regularly employed by public teamsters in hauling freight to and from railroad stations and to and from the water front.

The cartage charges between the business districts and the railroads differ in some cases from those between the business districts and the water front, but the average haul is nearly the same. Cartage charges, therefore, do not affect vitally the comparison of costs as between railroad and barge shipments when both require hauling at the terminal. The difference is chiefly between the rail and the barge rates, and, as shown above, the latter indicates a large saving.

For manufacturing establishments located at a distance from water terminals but provided with private railroad sidings, the third condition, the cost of transportation by barge plus cartage, would about equal the cost of all-rail transportation. From such establishments but little water-borne freight will be sent.

As regards the first and second conditions, as stated above, it is deemed certain that with an adequate canal, having a daily line of

[1] Appendix C 3.

barges plying between New York and Philadelphia, the freight rate being at least 50 per cent less than that charged by the railroads, and there being a certainty of their arriving at their destination on schedule time, a large percentage of the commodities now being shipped by rail under the first and second conditions would be diverted to water transportation. This is verified by numerous letters received from shippers in which they state that if the freight rate were reduced only 30 cents to 50 cents per ton they would ship the bulk of their freight by the canal, and estimate that their business would be increased by the construction of an adequate canal by 25 to 100 per cent. A prominent manufacturer of the upper Hudson states that sufficient manufactured and agricultural products are shipped from his region to the vicinity of Philadelphia to support a daily barge line. Similar conditions doubtless exist at other points, but it has been impossible to obtain any fixed data.

It seems impossible to get even an approximate estimate of the rail traffic from New York to Philadelphia and vice versa, originating and ending at these points or at the cities along the proposed canal lines, as the figures supplied by the railway offices appear to be fragmentary, showing a total but little larger than the known volume of water traffic between these two points.

As stated before, the total freight traffic, including foreign, of the Pennsylvania and Jersey Central systems within the New Jersey district may be placed at 54,000,000 tons, of which certainly a large proportion was handled between New York and Philadelphia.

The district affected by the canal is preeminently and increasingly industrial, requiring due consideration for the future in regard to the cheap movement of its raw material and food supply. According to the census of 1904 the industries in the Atlantic seaboard States used raw material to the amount of four and one-third billions of dollars and turned out a finished product valued at seven and three-quarter billions of dollars. Limiting the total to the territory adjacent to the leading ports between Bangor and Newbern, it appears that raw material to the amount of $1,900,000,000 was consumed and a finished product turned out amounting to $3,400,000,000 per annum. Of this amount $1,472,460,000 of raw material and $2,641,917,000 of finished products originated in the section directly tributary to the New York and Philadelphia Canal. Within this field lies the greatest and the most rapidly growing industrial district of the United States. Between Bangor and Newbern, according to the United States Geological Survey, there was a mineral production in 1908 valued at $591,000,000 and within the territory from Maine to North Carolina there was, according to the census of 1904, a lumber production valued at $116,000,000, or, adding the seaboard and Gulf States south of North Carolina—all of which make northbound shipments—the total production was valued at $225,000,000. Within the same territory, from Maine to North Carolina, inclusive, the value of farm products, according to the Agriculture Department report, amounted in 1909 to $688,000,000, and this total does not include truck farming or dairy products, two items of rapidly increasing value.

The coal mined within the same territory amounted in 1907 to 246,138,812 tons, valued at $385,528,274, of which a large proportion is shipped to eastern and northern ports by rail and by sea.

From the five leading ports—namely, New York, Philadelphia, Baltimore, Norfolk, and Newport News—43,411,371 tons of coal were shipped by water in 1910 (Appendix C 3).

Each year shows an increase of farm and truck products interchanged between the north and south Atlantic coasts. Perishable fruits and vegetables can be transported most economically by vessels suited to canal navigation and it is highly probable that the construction of an Intracoastal Waterway would give a great impulse to this class of traffic. To-day the North is dependent on the south Atlantic coast for the greater part of its winter and spring vegetables and fruits. Conversely, the South depends on the North for its seed potatoes, apples, and other food products.

An examination of the coastwise traffic of the United States shows a dimunition of available vessels more pronounced than is generally realized, while the total tonnage of vessels on the Atlantic and Gulf coasts has increased, according to the census, from 2,600,000 tons in 1889 to 4,800,000 tons in 1906. The increase has been in steamships, barges, and unrigged craft, operated principally by transportation companies, and the independent sailing tonnage available for all kinds of commerce has been steadily decreasing. The storms of every winter take their toll of vessels, cargoes, and lives, and the loss is not made up. The cost of ship construction and operation, the risk of loss on our stormy coast, and the consequent prohibitive rates of marine insurance have combined to drive the American flag from our own coasts, as well as from the high seas, and the disappearance of our coastwise fleet of sailing vessels, seems as certain as that of the foreign fleet which half a century ago was carrying our products for trade to all parts of the world. The fleet is being replaced, as the needs of established lines require, by steam-towed barges and unrigged craft of various kinds. The Census Bureau reported in 1906 a total tonnage of unrigged craft on the Atlantic and Gulf coasts of 2,250,000 tons, exceeding steam tonnage by 1,250,000 tons, and sail tonnage by more than 1,000,000 tons, and comprising nearly 47 per cent of the total tonnage.

The reason for this condition is shown by one company transporting coal between Philadelphia and New England ports. The sailing vessel formerly used in the service could carry not more than 1,200 tons, and the fleet employed could deliver in 500 voyages about 600,000 tons per year. The employment of tows of barges carrying from 1,600 to 3,300 tons per barge makes it possible, at a greatly reduced cost of operation, to deliver in 300 voyages comprising 1,150 barge cargoes 2,500,000 tons per year. The same conditions must apply to all other forms of coastwise low-grade bulk-freight traffic, and it may be predicted that within the near future it must be made possible for water-borne traffic to be carried in this or a more efficient type of craft, or else it will cease to exist as an independent factor in transportation. The tendency of the changes in water-borne freight carriers is toward a type of craft for which a sheltered waterway offers the most advantageous conditions. The reduced cost of transportation, in the judgment of the board, would not greatly affect the shipment of those classes of commodities which yield an attractive profit to the railways. It would result rather in the development of new lines of traffic which would contribute greatly to the industrial development of the territory affected and to the feeding of its popula-

tion, while the lower cost of many important lines of raw materials, as well as the decreased cost and increased radius of production of the food supply, would combine to stimulate and increase the output of finished products, which constitute the principal source of profit of railway operations. Furthermore, the board believes that the results shown along the routes of other canals, such as the Erie Canal and the canalized rivers of the United States and in Germany along the Finow Canal and the canalized Main River, indicate a large development of local industry along the line of the canal itself and the waterways tributary thereto, and an increase in production of farm, garden, and dairy products, within a wide territory, and yet available for cheap and prompt delivery to the great and growing centers of population.

Germany, France, and Belgium have constructed extensive systems of canals connecting the important points of production, particularly of minerals, with their seaports and important centers of consumption. In each of these countries, the canals that carry mainly coal and low-grade mineral products are the busiest ones; and in all these cases the railroads have profited greatly from the construction of the canal. A study of the recent development of the Rhine-Westphalia coal and iron district, its canals, railroads, and manufacturing plants, will plainly show this.

It has been shown that 1,800,000 tons of freight are shipped annually by water between Philadelphia, New York, Providence, and Boston notwithstanding the high rate of freight and the perils of the outside route. It seems fair to assume that were the canal constructed, this tonnage would pass through the canal and would be increased between these ports by 100 per cent, owing to the lower freight rates, the quicker transit, and the safer route.

Furthermore, the manufactures of the New England States require the products of the Southern States and vice versa, and, it is estimated that at least 2,000,000 tons of freight, mainly coal, will use the canal between New England States and the Southern States. This would make a total estimated annual tonnage of 5,600,000 tons which would probably use the canal during the first few years. If we take as a very conservative estimate of the saving by shipping via canal against all other routes, 40 cents per ton, this would make a total reduction of the cost of transportation of $2,240,000.

Cost of constructing the canal	$45,000,000
Three per cent of this amount equals	1,350,000
Annual maintenance	312,217
Total	1,662,217

DELAWARE RIVER-CHESAPEAKE BAY SECTION.

Projects for connecting the Delaware River or Bay with Chesapeake Bay by means of a canal have long been under considerstion. As far back as 1824 work was begun on a canal joining the Delaware River at Delaware City with the Chesapeake through Back Creek and Elk River and in 1829 the water was let in for the first time. This canal is 36 feet wide at the bottom and 10 feet deep $13\frac{5}{8}$ miles long and contains three locks 220 feet long in the clear by 24 feet wide in the clear. The summit level is 16 feet above mean low water in

Delaware River. The total cost has been reported as $2,250,000 (Appendix E Senate Document No. 215 59th Cong., 2d sess.), of which one-fifth was contributed by the United States, $100,000 by the State of Pennsylvania, $50,000 by the State of Maryland, and $25,000 by the State of Delaware; the remainder by citizens of the three States. The Chesapeake & Delaware Canal Co. reports the total cost to June, 1910, as $3,989,365.17. See letter from company dated June 14, 1910. (Appendix D 1, p. 247.)

This canal is still in operation carrying a restricted commerce between Philadelphia and Baltimore, including a regular daily and nightly passenger service. The small dimensions of the canal, the unstable banks which admit of low speed only, and the tolls charged upon all boats and their cargoes have prevented the development of a commerce proportionate to the commerce of the great bays connected by the canal.

In 1871 there was held in Baltimore a national commercial convention, and a movement toward a ship canal between Chesapeake and Delaware Bays was inaugurated which resulted in a request from the House of Representatives to the Secretary of War for information relative to the subject.

In 1882 the river and harbor act directed the Secretary of War to cause surveys to be made and to report upon the various routes. Under this law a number of routes were surveyed.

The river and harbor act of 1894 authorized the President to appoint a board to "examine and determine, from the surveys heretofore made under the direction of the War Department, the most feasible route for the construction of the Chesapeake & Delaware Canal." The report of this board is published in Executive Document number 102, House of Representatives, Fifty-third Congress, third session. The route of the present Chesapeake & Delaware Canal was recommended for adoption.

In 1906 a joint resolution of Congress authorized the appointment of a commission to appraise the works and franchises of the Chesapeake & Delaware Canal, with reference to the desirability of purchasing the said canal by the United States and of constructing over the route of this canal a free and open waterway, and also, so far as possible by means of the surveys already made under the War Department, to investigate the feasibility of the route known as the Sassafras route. The commission was directed to submit to the Secretary of War a report with its conclusions upon the probable cost and the commercial advantages and the military and naval uses of each of the said routes. The report of the commission is published in Senate Document No. 215, Fifty-ninth Congress, second session, and favored the adoption of the route of the present Chesapeake & Delaware Canal.

In all of these earlier investigations the principal object in view was to provide the city of Baltimore a direct and safe outlet to the ocean. Naturally, the pressure for the desired outlet has originated largely in Baltimore, and a satisfactory solution of the problem presented demanded that the outlet should be as direct as possible. At the present time, however, an entirely new element has arisen for consideration, which modifies materially the requirements of the case. This is the development of a much broader project to provide an inland waterway from Boston to the southern Atlantic ports. The canal connecting the Chesapeake and Delaware waters has become

merely a link in the whole chain of waterways, and its relation to a single port is no longer the controlling consideration; but it is proper and necessary to give this relation due weight in the selection of the route to be adopted.

THE MOST AVAILABLE ROUTE.

It is the duty of the board to examine all practicable routes and to prepare plans and estimates of the cost along the most available route. In making this examination, the board has availed itself of the information heretofore collected and compiled in the earlier reports of examinations, investigations, and surveys and has examined personally all practicable routes formerly suggested as well as some later modifications of the same.

The peninsula lying between the waters of Chesapeake and Delaware Bays is too well known to require description other than to point out those peculiar characteristics which have a bearing upon the present problem. It is of recent geological formation, consisting of the softer materials such as sand, clay, gravel, marl, mud, and loam, all of which can be excavated easily and economically by modern methods.

The narrowest part of the peninsula is at its northern end where an arm of Chesapeake Bay penetrates to about 12 miles from the Delaware River. It requires but little imagination to conceive this river's flowing into Chesapeake Bay instead of into Delaware Bay, and the natural position for a connection between the river and Chesapeake Bay lies across the narrow isthmus.

The width of the peninsula steadily increases toward the south until at the southern limit imposed by the condition embodied in the law that the projected waterway shall open into Delaware River or Bay the width is at least four times that of the narrowest part.

The eastern or Delaware shore of that part of the peninsula under examination consists of marshes several miles in width, frequently overflowed by high tides and rising nowhere more than four feet above tide water. The western or Chesapeake shore is bluff and stands generally high above the water. It is indented deeply by several estuaries. On account of the height of the land at the western side, all practicable routes utilize the natural channels of estuaries.

Along the central part of the peninsula runs a ridge which must be crossed by all available routes and which is narrowest and highest at its northern end, at which point it is about 100 feet above tide water.

The estuaries along the Chesapeake shore are in order beginning at the south, Nanticoke, Choptank, Chester, Sassafras, and Elk Rivers.

The Nanticoke River is conveniently situated for a line connecting Philadelphia and Norfolk, but it affords a very poor route from Baltimore to the ocean and leaves that city off the main line of the Intracoastal Waterway. It has no compensating advantages and is so markedly inferior to other available routes that it may be rejected without further consideration.

Several routes running from the Choptank and Chester Rivers have been proposed and examined heretofore. While fairly convenient for a canal connecting Baltimore Harbor and the Atlantic Ocean,

they are not suited for adoption as a part of the general scheme for a continuous waterway. Their general direction lies about at right angles to the proper course of such a waterway; they all cross the peninsula where its width is great; estimates of cost already made show that they would be expensive to construct; they all enter Delaware Bay on a shore where there is a considerable littoral movement of sand which would make the maintenance of a channel to deep water difficult and costly; and lying well outside of the existing outer defenses of the Delaware, they all open to the ocean a convenient passage to the ships of enemies. In the opinion of the board, the last named objection alone is sufficient to demand the rejection of these routes. Not only are they located conveniently for the use of an enemy, but they are extremely difficult to defend against attack by land as well as by sea. Should a ship canal located on any of these routes fall into hostile hands, defenses at the entrance to Chesapeake Bay would at once become useless, the waters of Chesapeake Bay would be opened to the ocean and the cities of Baltimore, Annapolis, and Washington would be exposed to grave danger.

So vital do these considerations appear that it is the opinion of the board that no route should be adopted that does not enter Delaware River at a point within the protection and control of the fortifications already constructed. If this view be accepted, all routes entering Delaware River or Bay south of Reedy Point must be rejected without further consideration. This applies to all the Sassafras River and Bohemia River routes as well as to those already mentioned, for the most northerly route utilizing these rivers enters the Delaware River 4 miles south of Reedy Point.

The only route free from this defect is one substantially along the line of the present Chesapeake & Delaware Canal. This route has, therefore, been examined with especial care in order to determine whether it possesses any advantages or disadvantages of sufficient weight to control decisively its selection or rejection.

Its principal advantages are as follows:

Its location and general direction are well suited to its use as a part of the general intracoastal-waterway project.

It crosses the peninsula at its narrowest part.

The materials to be excavated in construction are all adapted to easy, rapid, and economical work.

It intersects fewer routes of land travel than other routes available.

It shortens the distance from Baltimore to Cape Henlopen by 184 miles.

It enters the Delaware River in the immediate vicinity of the present fortifications and well within their protection.

Its small length of land cut, combined with its northerly position and the reduced number of land approaches, make it the route most easily defended against land attack.

The maintenance of its channel where it enters the Delaware River and Chesapeake Bay presents no serious difficulty.

The cost of a canal by this route will be less than by any other available.

The construction work can be so conducted as to permit the uninterrupted use, toll free, of the canal for commerce as soon as the Government acquires possession.

Objections to this route have been made as follows:

The ridge crossed by the canal is about 100 feet high at its summit, and is composed of strata liable to slips when the banks are saturated with water.

Borings into the strata, which must be cut by the enlarged section for a ship canal, have been alleged to indicate the presence of quicksands.

The northerly position of this route has caused apprehension that ice would interfere with traffic more than upon other routes.

These disadvantages present no insuperable obstacle to the construction of a canal on this route, and similar difficulties will probably be met on any route selected. The many positive advantages possessed by the route are believed to outweigh any probable increase of cost due to the disadvantages alleged, and it is the opinion of the board that the most available route lies substantially along the line of the present Chesapeake & Delaware Canal.

In this connection it is worthy of note that this line was selected for the present canal at a time when primitive methods were employed. The attack with pick and shovel on the ridge at its highest point proves that the engineers who directed the work were convinced that they had selected the line of least resistance. The lapse of years has not altered the physical conditions.

The board of 1894, ordered to determine the most feasible route, reported:

> After examination of the surveys heretofore made under the direction of the War Department, this board determines the most feasible route for the construction of the Chesapeake & Delaware Canal to be the Back Creek route, which is substantially located upon the line of the existing Chesapeake & Delaware Canal.

The commission appointed in 1906 reported in favor of the route of the present Chesapeake & Delaware Canal as compared with the Sassafras River route.

The present board also believes that a route substantially following the Chesapeake & Delaware Canal is the most available, and has caused a survey to be made, and has prepared plans and estimates for a canal along that route.

THE PLAN.

The alignment.—The Delaware City terminus of the existing canal is not well adapted to enlargement. It introduces an objectionable curve in the alignment of the canal about a mile from the entrance, and strikes the Delaware River in a minor channel between the Delaware shore and Pea Patch Island. To utilize this entrance would involve the improvement and maintenance of this minor channel, now about 20 feet deep, throughout its entire length; for if a Delaware River approach were provided around the northern end of the island only, vessels of considerable draft issuing from the canal and bound south would be forced to make a long detour, and a similar detour would be made by northbound traffic if an approach around the southern end of the island only were provided. An even more serious objection to the present entrance is found in its direction with respect to the tidal currents in the river and the probability of a consequent shoaling, which, for a sea-level canal, would make the maintenance of the channel under such conditions difficult and costly.

These objections do not apply to a line striking the river at Reedy Point, as shown in the plan accompanying this report. (Sheet No. 1.) This line is free from curvature and traverses marshland, where excavation will be rapid and cheap, and where damages for land taken will be slight as compared to those for property in Delaware City.

It is not proposed to abandon entirely the present entrance. By a slight deepening it can be retained for the use of light traffic bound to or from the north, thus relieving the main entrance from the large numbers of small vessels, pleasure craft, etc., that will doubtless use the canal, and at the same time lessening the loss to Delaware City that would be caused by the abandonment of the present entrance.

The new entrance planned by the board has the additional advantage of being well defended by the fortifications at Fort Du Pont and of increasing the strength of the fortifications against a land attack. The retention of the present canal in rear of the fortifications, as described above, also affords an increase of strength.

The erection of wharves and buildings at Reedy Point would mask the guns of the defense, which should not be permitted. To obviate this difficulty, it is proposed to widen the canal from Reedy Point to the proposed highway bridge at Station 11 + 600. Wharves, warehouses, and other buildings may then be erected which will be outside of the field of fire of the guns, and a safe port will be provided for vessels waiting for tugs to take them through the canal or for other purposes. To insure a clear field of fire for the guns of the defenses, it is believed to be necessary for the United States to purchase all the marshland within the field of fire.

From the point of junction of the new entrance and the present canal to Chesapeake City, the proposed canal follows closely the line of the existing cut. At Deep Cut a study has been made of the high banks where in the past slips have occurred. Borings were made to determine the strata through which the enlarged channel will run, and a new line was surveyed leaving the canal at Crystal Run and avoiding Deep Cut entirely. Earlier investigations were thought to have disclosed the existence in Deep Cut of water-bearing sands, sometimes described as quicksands, which flowed freely into the boring apparatus and which threatened the canal with serious slips.

The estimates of the board show that a cut on the Crystal Run line would increase the cost of the canal about $1,500,000 over that of the Deep Cut line. In comparing the two routes, particular study has been given to those dangers and difficulties which exist on the Deep Cut line and which it had been hoped to avoid by adopting the other.

The only dangers apprehended were those due to unstable material in the banks and to quicksands in the subsoil.

When the present cut was made, hand methods of excavation were employed, and consequently the side slopes were left as steep as they would stand and the excavated material was deposited along the very edges of the cut. In the firmest material, this procedure must inevitably produce conditions conducive to slips in the banks. Such slips have been numerous in the past and some of them have been of considerable extent. In recent years, however, the banks appear to have been reasonably stable and permanent. The only movements of the material of the banks of Deep Cut have been of the

kinds usually observed in excavations, and may be classified as follows:

A. Erosion.

B. Slips due to undercutting of the foot of the slope.

C. Slips due to the presence of water at the upper surface of a stratum of clay, causing such surface to become more or less lubricated.

D. Flowing of material due to saturation by water and consequent change in the angle of repose.

The first class named above presents no unusual features, and can be controlled by ordinary means such as the employment of easy slopes, drains, and suitable grasses.

Slips of Class B are found commonly along the south bank of the present canal. No towpath or berm was constructed on that side, and where the banks were not revetted, or where the old revetment has failed, the water has undercut the banks, and the cohesion of the soil has been insufficient to support the portion of the bank so undercut. The cross section proposed for the new canal has a berm above the water surface along both sides of the canal, which is believed to be a sufficient protection against this kind of slip, and, in addition, revetments are contemplated wherever necessary.

The largest slips, as well as the most numerous, are of Class C. There is no uniform stratification in the banks of Deep Cut, but the general rule seems to be a heavy layer of sandy soil at the upper surface resting upon a stratum of clay. Throughout the region of slips numerous springs appear along the banks at the dividing surface between the sandy soil and the supporting clay. No slips are found which do not show water at the foot, either the water of the canal cutting away the foot of the bank or springs issuing from the bank as just described. It is thought safe to conclude that all the slips that have occurred heretofore have been caused principally by water. Where a slip has provided a ready escape for the water percolating through the bank, the bank has generally ceased to slide, and in some places where this has occurred the bank has remained for years standing at a very steep slope.

The construction of a sea-level canal with its water surface even as much as 16 feet lower than the present water surface can not be expected to lower materially the ground water in the banks, because of the numerous strata of impermeable clay. Much of the ground water is now discharging well above the surface of the water in the canal, and this will continue to discharge at the same level after the canal is lowered.

The lowering of the water surface, however, is not expected to increase the danger of slips, because the new slopes will be much flatter than most of the existing slopes and it will probably be possible to provide safe means of escape for the percolating waters. Slips will probably occur from time to time, but the recent experience of the present canal does not give cause for alarm. Slips great enough to block the present small channel have not occurred in recent years, and those of early days were due largely to the steep slopes and surcharged banks, conditions which will not obtain in the proposed work.

Movements of Class D are found along the present canal where the soil is at times so saturated with water that it is subject to a

gradual flowing as a thick viscous mass. At some points the pile revetment has been pushed out into the channel, the piles being sheared off at the surface of the fixed hard pan below the moving stratum. The most successful remedy applied so far appears to have been to provide an escape for the water so that the soil should not become saturated. Even where no remedy has been applied, the movement has been so slow that comparatively little dredging has been necessary to remove the material entering the canal.

All of the above-described sources of instability in the banks are to be expected on the Crystal Run line as well as in Deep Cut, and therefore there appears to be no good reason for a change of route at increased expense.

No conclusive evidence of the presence of quicksand at any point in Deep Cut has been found. Over a length of about 7,000 feet of the line borings have reached a deposit of white sand which was formerly believed to be a quicksand that would flow up several feet into the boring pipe. The apparatus employed in making the borings consisted of a casing pipe driven vertically downward by a hammer, and a wash pipe of much smaller diameter working within the casing pipe. The lower end of the wash pipe was provided with a cutting point, and water was pumped down through the same pipe to rise between the two pipes and carry to the surface the material loosened.

The reports have stated that the sand would flow into the casing pipe and rise high enough to jam and lock the wash pipe, which could then be raised only by great force. This same sand, however, has proved to be very hard and compact; so much so that the borings could be made through it only with difficulty. It is stated in the reports that 12 to 14 blows of a 500-pound hammer falling 6 feet were necessary to drive the pipe 1 inch.

It is believed that the apparent flowing of the sand is not real. It is apparent that if the upward velocity of the water in the casing pipe does not exceed the downward velocity of the sand grains in settling through the same water, no sand will reach the top of the pipe. A cessation of the pumping will then cause the suspended sand to settle and jam the wash pipe. The same thing will happen to a decreasing degree as the velocity of the water is increased. The jamming of the wash pipe is, therefore, by no means conclusive as to the flowing of the sand as reported heretofore. Still further doubt is thrown upon the existence of a flowing sand by the fact that when the pump used in boring was replaced by a larger and more powerful one the supposed inflowing of the sand was no longer noted, the explanation being that the sand particles were carried to the surface more rapidly and there were fewer held in suspension to settle back when pumping ceased.

The borings on the Crystal Run line discovered a sand similar in appearance to that found in Deep Cut, but reported not to possess the property of flowing. It is significant that these borings were made with the larger pump.

The sand which has caused apprehension is fine, and when unconfined and supersaturated with water is very unstable. When even slightly confined it becomes compact and extremely hard and firm. It is believed that it is in no sense a quicksand and that it will not flow under pressure; but doubtless it will wash away readily when its surface is exposed to the action of flowing water. Water percolating

through the mass of the deposit and flowing out at an unprotected surface will carry some of the sand with it, thus causing the mass to crumble.

Where this material is not actually exposed in cutting the canal prism it should give no trouble. Where actually cut through, the sand will be somewhat unstable, especially if ground water issue through it with considerable force. The great compactness of this sand in situ is unfavorable for such a condition to exist, but if it should occur, erosion of the bottom of the canal might take place whenever the velocity of the tidal currents is sufficient to carry away the live sand grains. In this case the canal would gradually deepen at the site of the sand deposit, and when the depth had increased to the proper point the process could be stopped permanently by placing a blanket of hard material on the bottom of the cut.

The same action of the material at the side slopes of the canal would probably be more serious. The surface of the slopes would drift away until the overlying material was undercut, when this harder material would sink and stop the further erosion of the sand. As the sand is not found nearer than 16 feet to the water surface of the canal, no great damage is to be expected to the high banks, the worst that could occur being generally outside of the berm.

It is believed that the damages arising from the presence of this sand will not be of sufficient importance to cause a change of route at an increased cost, especially as the alternative route may be expected to present similar difficulties.

The cross section.—The law under which the board is organized and has conducted its investigations prescribes 25 feet as the maximum depth to be considered. This depth would permit nearly all of the coastwise water-borne traffic now plying between Baltimore and ports of the northern Atlantic coast to use the canal advantageously, saving time and distance and avoiding the dangers of the exposed waters from Cape Henlopen southward to Cape Charles. A large part of the foreign commerce of Baltimore with Canadian and European ports could also use to advantage a canal of this depth. The saving from this cause is estimated as not less than $200,000 annually.

A depth of 18 feet would permit few of the vessels engaged in this commerce to utilize the canal. The difference in cost of a canal 25 feet deep and one 18 feet deep is $2,400,000 if the sections are proportional, but it is believed that the minimum width regarded as permissible for the deeper canal could be reduced but little for the lesser depth, and not at all if the canal were designed with a view to future deepening to 25 feet. If the canal were constructed with the smaller section and widened later, the work would involve the loss of all revetments, slopes, and slope protection along one bank, and the excavation of material from an unfavorable position on the surface of the slope. The cost of enlargement would far exceed the increase in cost due to constructing the proper section in the first place.

For these reasons the actual saving in first cost of an 18-foot canal as compared with a 25-foot canal is only about $700,000, a sum not sufficient to justify the sacrifice of the benefits expected from the greater depth.

The minimum width to permit vessels to move at a speed of 8 to 10 miles per hour and to pass each other with safety is taken as 125 feet at the bottom; at all curves this width is increased.

As a result of the experience on the existing canal, the side slopes have been designed to be nowhere steeper than 1 vertical to 2-1.2 horizontal, with a berm not less than 10 feet wide above the high-water level. Provision is made for revetting the slopes wherever necessary to protect them against the waves of passing vessels.

Locks.—During the year 1871 there were 16,394 passages through the canal, according to the reports of the canal company. With the growth of rail transportation the canal traffic has fallen off, so that for the last three years the passages through the canal have been about 5,000 annually. The enlargement of the canal and the abolishment of tolls can not fail to restore to this route a traffic which would demand locks so large and costly and a pumping plant (to supply water for the summit level) so expensive to construct and operate that a tide-level canal would be cheaper to construct, to operate, and to maintain.

Careful consideration has been given to the possible need for a guard lock to prevent excessive currents in the canal due to differences of level in the water of Chesapeake Bay and the Delaware River, and the conclusion has been reached that currents having velocities sufficient to damage the banks seriously or to interfere with navigation are so unlikely to occur, even during the most favorable conditions for their development, that the large expenditure necessary for a guard lock would not be justified.

The plan therefore provides for a tide-level canal without locks.

Bridges.—The following statement shows the bridges which will be required to carry highways and one railway across the canal. The bascule type of drawbridge has been adopted for all crossings, and the clear width of waterway through each of the bridges is 150 feet:

Crossing.	Type.	Bridge.	Present angle to normal.	Length of track or road relocation	Clearance at mean low water.
			° ′	*Feet.*	*Feet.*
Delaware City	Highway	Draw	16 55		12
Do	...do	...do	(1)	2,184	24
St. Georges	...do	...do	5 7		24
Canal Station	Railroad	...do	16 45		52
Buck Bridge	Highway	...do	12 45		66
Bethel	...do	...do	25 00		24
Chesapeake City	...do	...do	22 45		24

1 Normal.

The estimated cost of construction of the above bridges is $625,000.

Estimate of cost.

Excavation.	Quantity.	Unit.	Unit price.	Item cost.
Delaware River channel to jetties, 600 feet wide, 1 on 10 slope.	482,127	Cubic yards.	$0.12	$57,855.24
Outer end jetties to highway bridge, 300 feet wide, 1 on 2½ slope.	3,504,832	.....do......	.12	420,579.84
Bridge to junction with old canal, 125 feet wide, 1 on 2½ slope.	1,765,864	.....do......	.15	264,879.60
Junction with old canal to Deep Cut, standard section	6,784,002	.....do......	.15	1,017,600.30
Deep Cut section, standard section	15,572,826	.....do......	.20	3,114,565.20
Deep Cut to Back Creek, standard section	4,238,563	.....do......	.15	635,739.75
Back Creek to Elk River, 125 feet wide, 1 on 5 slope	2,700,542	.....do......	.15	405,081.30
Elk River to Chesapeake Bay, 250 feet wide, 1 on 5 slope.	2,617,748	.....do......	.12	314,129.76

Estimate of cost—Continued.

Excavation.	Quantity.	Unit.	Unit price.	Item cost.
Chesapeake Bay, 600 feet wide, 1 on 5 slope	4,568,362	Cubic yards.	$0.12	$548,203.44
Deepening old canal entrance at Delaware City, 36 feet wide, 1 on $2\frac{1}{2}$ slope.	406,835	....do......	.15	61,025.00
Scotts Run, 20 feet wide, 1 on 2 slope	9,294	....do......	.15	1,394.10
Total excavation	42,650,995	....do......		6,841,053.53
Bridges, 6 highway, 1 railway				625,000.00
Highway reconstruction	2	Miles	7,000.00	14,000.00
Bank revetment	134,000	Linear feet	7.00	938,000.00
Special revetment, Deep Cut	12,000	....do......	15.00	180,000.00
Bank revetment, old branch	14,300	....do......	3.00	42,900.00
Slope protection, Deep Cut	20,000	Cubic yards.	.25	5,000.00
Drainage ditches	24,900	....do......	.20	4,980.00
Pile dolphins	82			6,000.00
Jetties, Delaware River	2,550	Linear feet	25.00	63,750.00
Wharves				30,000.00
Drops for entering streams				3,000.00
Land and land damages, high land	903	Acres	200.00	180,600.00
Same for marsh land	750	....do......	100.00	75,000.00
Engineering and contingencies, about 10 per cent				900,926.47
Total				9,910,210.00
To this should be added the cost of acquiring the holdings of the Chesapeake & Delaware Canal Co. (see next paragraph).				2,514,289.70
Grand total				12,424,499.70

ACQUISITION OF PRIVATE WATERWAY.

The route selected coincides with the line of the present Chesapeake & Delaware Canal, which canal should therefore be acquired by the United States. Since the purchase of this canal and the abolishment of tolls will produce at once a saving of over $163,000 annually, this sum being about the average paid for tolls in recent years, and will certainly be accompanied by a substantial increase in the traffic through the canal to the advantage of the commerce of several States, its immediate purchase is recommended.

The commission appointed by the President of the United States in 1906, whose report is printed in Senate Document No. 215, Fifty-ninth Congress, second session, made a careful appraisal of the property of the canal company, giving due consideration to the cost of the canal and its present value based upon its earning capacity, and recommended that no higher price than $2,514,289.70 be paid.

No betterments have been added since 1887. (See letter from the canal company dated June 14, 1910, Appendix D 1.)

In declining to state a price for its property the company has reiterated its statements made to the above-named commission, and the status remains practically unchanged since the date of the report mentioned. (See letter from the canal company dated July 12, 1910, Appendix D 2, p. 248.)

The board recommends that no higher price than $2,514,289.70 be paid for the holdings of the Chesapeake & Delaware Canal Co., and that if these holdings can not be obtained by purchase at this price, or less, condemnation proceedings be instituted.

MAINTENANCE.

Dredging for maintenance may be required continuously, or, if intermittently, upon extremely short notice. For this reason a suitable dredge should be kept on hand at all times. The dredging is free

from rock or other very difficult material, and a single seagoing dredge equipped to rehandle its load should be sufficient for all ordinary purposes. In cases of emergency contractors will be available in Philadelphia and Baltimore.

The care of the slopes presents a problem incapable of definite solution, for neither the magnitude nor location of erosion or slips can be predicted accurately. A sufficient organization is therefore provided for in the estimates to maintain constant inspection, repair minor damages, and cultivate suitable grasses and other vegetation to bind the slopes.

With properly located jetties little ice need be admitted from the Delaware River. The ice from the Susquehanna at times blocks the mouth of Elk River. With the constant passage of steel steamers through the canal it is improbable that ice will form extensively in the canal itself or increase in thickness sufficiently to block the channel. Only the most severe winters can be expected to interfere seriously with the navigation of the canal, and then only for brief periods. Until experience has shown a special ice-breaking plant to be essential, and commerce through the canal shall have developed to such an extent as to make short and infrequent periods of interruption threaten losses to commerce great enough to justify the expense, no provision for ice breaking need be made.

Estimate for maintenance, including first cost of plant and annual expenditures.

	First cost.	Annual expenditures for operation and repair.
Inspection, supervision, and repair:		
Salaries of personnel		$21,720
Office, quarters, tool houses, etc	$20,000	1,200
Launch, rowboats, instruments, etc	5,400	1,500
Repairs to banks, revetments, and jetties		10,000
Dredging, 1 seagoing hydraulic dredge	200,000	42,000
Lighting and power:		
Power plant	150,000	12,000
Operating bridges		15,800
Total	375,400	104,220

It is probable that in time commerce may seek the canal to an extent which will demand regulation of traffic by a police force with patrol boats, preferably tugs for handling vessels in difficulty; but this item is not considered sufficiently urgent at present to require an estimate.

THE COMMERCIAL NECESSITY FOR A CANAL CONNECTING CHESAPEAKE AND DELAWARE BAYS.

This section is a central link in the chain of waterways proposed between Boston and Beaufort. Apart from any usefulness which it may possess for local commerce, or such interstate and foreign commerce as may use it to reach the ocean, it is essential to the construction of any intracoastal waterway connecting New York or Philadelphia with the South. But without reference to this relation to the other sections of the system proposed, the usefulness of the canal may be considered first in its relation to existing waterways and their commerce.

During the last five years many vessels and lives have been lost along the coast between Cape Charles and Cape Henlopen, between which points there is no harbor of refuge except the inadequate one at Chincoteague. Among the vessels so lost were 32 engaged in the coastwise trade which might have used the canal, if the same had been available and free, and which would in that way have avoided the dangers which caused their loss. The value of these vessels and their cargoes is not known, but the aggregate tonnage was about 22,600, and it may be assumed that there was lost with them not less than 12,000 tons of freight. Vessels of this class generally carry all that can be loaded upon them, and the above assumption is conservative.

Allowing 50 per cent of the cost of new vessels of the sizes reported, their value may be assumed as $450,000. Considering the total tonnage and value of all freight reported to the board as shipped along the route of the canal, an average value of $4.81 per ton has been deduced for the general run of coastwise freight. The cargoes lost may then be assumed to be worth not less than $57,720, and the value of the canal as a preventive of marine disaster may be taken as not less than $100,000 per year; in addition to which must be considered the great reduction in insurance rates on the total volume of coastwise traffic now running outside the capes but ready to change to the canal when possible. There are no statistics available from which the amount of this saving may be obtained. With the 32 vessels mentioned above were lost 49 lives, an average of about 10 per year.

Vessels engaged in the coastwise trade are not required to enter and clear at the customhouse, for which reason the character and volume of this trade are not readily ascertainable.

Letters requesting information as to their own individual shipments were sent to commercial organizations, boards of trade, and all shippers whose names could be secured, and in many cases large shippers were personally interviewed, sometimes several calls being made before the desired information was obtained, and in other cases repeated visits secured no information. No information could be obtained from underwriters of marine insurance

The data obtained can be only a fraction of the total commerce, but the statement below is compiled from the figures received from shippers as to their own shipments, and may be considered authentic as far as it goes. Some of the heaviest shippers were among those who failed to furnish figures.

According to the responses received, the following existing commerce could and would use a free canal to advantage:

Shipments from southern points.

	Tons.
Iron	120,000
Lumber	496,889
Tomatoes	1,361
Coal	240,000
Chemicals	17,000
Paints, etc	600
Miscellaneous	231,564
Total	1,107,414

In addition to the above there was reported freight amounting in value to $375,000, but the tonnage was not stated.

Shipments from northern points.

	Tons.
Bridge iron	18,000
Coal	872,518
Tomatoes	16,748
Oils	600
Granite, etc	40,111
Fruit	300
Miscellaneous	481,931
Total	1,430,208

In addition to the above, freight worth $195,000 was reported, but the tonnage was not stated.

The total shipments reported amount to 2,537,622 tons, valued at $14,170,239.

According to the reports of the Chesapeake & Delaware Canal Co. the average annual shipments through the canal for the last five years have been 716,644 tons, for which the tolls have averaged $163,151.33, or a general average of 22¾ cents per ton. Applying this general rate to the traffic reported as now existing and ready to use a free canal, we find that a free canal would produce a saving on tolls not less than $577,309 per year. In addition to the saving on tolls, a further saving of 21¾ cents per ton on the general run of freight is estimated as probable, due to the cheap transportation expected to develop over a free route. The saving from this cause would be not less than $551,933 per year.

It should be noted that the figures given above are only partial and may be taken as conservative and well below the actually existing amount of commerce.

Without considering the saving in insurance, the annual saving on known existing coastwise commerce which would use a free canal may be stated as not less than $1,229,242. The actual saving on all coastwise commerce which would use the canal, including that commerce now existing but not reported, would probably be considerably in excess of this amount.

Another distinct value of the canal is found in its short route from Baltimore to the ocean, which would give to all shipping bound to or from European, Canadian, or northern Atlantic ports a positive saving in time. From this city to the ocean outside the entrance to Delaware Bay (a point passed by all coastwise traffic to north Atlantic United States and Canadian ports, as well as all ocean traffic to Europe) the distance via Cape Charles is 320 miles. To the same point the distance via the proposed canal is 136 miles. The saving in distance is 184 miles, and in time about 16 hours for steamers.

An investigation of this saving shows that the annual traffic between Baltimore and domestic ports which would be benefited in this respect by a free canal affording 25-foot navigation is as follows:

	Tonnage.
1,638 steamers annually	3,925,236
342 sailing vessels annually	348,288
342 barges annually	284,022

These figures probably include a part of the freight stated above as available for the canal, but as we are now considering saving of time only, and not tolls or cost of carriage, this is immaterial.

UNITED STATES INTRA - COASTAL WATERWAYS

BOSTON MASS.- BEAUFORT INLET, N C DIVISION

DELAWARE RIVER - CHESAPEAKE BAY SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, WILMINGTON, DELAWARE

WATERWAY BETWEEN

DELAWARE CITY AND POOLES ISLAND

DELAWARE AND MARYLAND

INDEX MAP

FROM SURVEYS OF 1909 AND U. S COAST AND GEODETIC SURVEY CHARTS

SCALE $\frac{1}{200,000}$

10 MILES

PREPARED UNDER THE DIRECTION OF

MAJ. R R. RAYMOND, CORPS OF ENGINEERS U. S ARMY

ASSISTANTS

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WILMINGTON DEL., OCT 4, 1911.

APPROVED

R R Raymond

MAJOR CORPS OF ENGINEERS, U.S. ARMY

The saving in time for a steamer is two-thirds of one day for each passage through the canal. There would thus be saved annually 1,092 days. The average daily cost of operating the class of steamer which carries the bulk of the coastwise trade is about $125. The annual saving is thus $136,500.

The foreign trade carried in vessels not too deep to pass through the canal is estimated as follows: Steamers, 480 annually; tonnage, 1,589,938. The saving in time is therefore 320 days, and the cost of operating may be placed at not less than $150 per day, or the annual saving may be stated as $48,000. This does not include the saving in time for sailing vessels and barges.

The saving in time stated above is by no means the full saving, for the time saved would be utilized by the vessels to perform additional work, earning a considerable sum which can not be estimated accurately.

The value of a free canal affording 25-foot navigation may then be stated as follows:

Annual saving in vessels and cargoes from shipwreck	$100,000
Annual saving in tolls	577,809
Annual saving in freight	551,933
Annual saving in time, coastwise traffic, steamers only	136,500
Annual saving in time, foreign trade	48,000
Total	1,414,242

These figures are based upon the commerce actually found to exist to-day. Commerce existing, but not specifically reported to the board or verified by investigation, has not been included; nor has any attempt been made to predict what increase in commerce would result from the opening of a free canal for 25-foot navigation. All shippers who have expressed an opinion on this matter are agreed that there would be a large increase.

It is unnecessary to repeat the discussion of the general principles governing traffic problems, which has been included in this report for the New Jersey section. The reasons there set forth are believed to justify fully a conclusion that the completion of an intracoastal waterway would be followed by a very great traffic through this section; but independent of any relation this canal may have to a through intracoastal waterway, its value to existing commerce is believed to be sufficient to justify its construction by the Government.

The immediate annual saving in tolls alone, after paying operating expenses equal to the average in recent years, would exceed 4 per cent on the recommended purchase price of the existing canal.

The enlargement of the existing canal can be accomplished without serious interference with commerce.

Summary of canal statistics, Delaware River-Chesapeake Bay section.

Length of land cut	miles	13.6
Length of dredged channel in Delaware River	do	.9
Length of dredged channel in Back Creek	do	4.5
Length of dredged channel in Elk River	do	8.5
Length of dredged channel in Chesapeake Bay	do	10.0
Distance from Baltimore to entrance to Delaware Bay via Cape Charles	miles	320.0
Distance from Baltimore to entrance to Delaware Bay via canal	do	136.0
Saving in distance from Baltimore to common point	do	184.0

Saving in time from Baltimore to common point .... hours..	16
Depth of canal at lowest low water .... feet..	25
Width of canal at bottom in land section .... do....	125
Width of canal at bottom in Delaware River .... do....	600
Width of canal at bottom in Back Creek .... do....	125
Width of canal at bottom in Elk River .... do....	250
Width of canal at bottom in Chesapeake Bay .... do....	600
Maximum slope in canal banks above water	1–2½
Side slope in dredged channel, land cut	1–2½
Side slope on dredged channel, Delaware River	1–10
Side slope in dredged channel, Back Creek	1–5
Side slope in dredged channel, Elk River	1–5
Side slope in dredged channel, Chesapeake Bay	1–5
Number of locks	None.
Number of highway bridges	6
Number of railway bridges	1
Excavation .... cubic yards..	42, 675, 595
Estimated cost of construction	$9, 910, 210. 00
Estimated cost of acquiring private waterway	$2, 514, 289. 70

NORFOLK-BEAUFORT SECTION OF THE INTRACOASTAL WATERWAY.

The portion of the waterway from Norfolk, Va., to Beaufort, N. C., may be subdivided into three parts: First, from Norfolk to Albemarle Sound; second, from Albemarle Sound to Pamlico Sound; third, from Pamlico Sound to Beaufort Harbor, and these subdivisions will be discussed in the above order.

NORFOLK TO ALBEMARLE SOUND.

The project for an inland waterway from Norfolk to Albemarle Sound has been the subject of many investigations and reports. The existence of natural channels to within a short distance of Norfolk early drew attention to the feasibility of such an inland route and led to the beginning of the Dismal Swamp Canal in 1787 by private individuals under a State franchise. This canal was completed some 30 years later and gave a continuous water route from Norfolk to Albemarle Sound, but of limited capacity. Another route via the Albemarle & Chesapeake Canal was commenced in 1856, and when opened gave a navigable depth of 8 feet from Norfolk to Albemarle Sound. This new canal, being of greater capacity than the then Dismal Swamp Canal, attracted to itself practically all commerce passing from Norfolk to Albemarle Sound. The Dismal Swamp Canal deteriorated rapidly, and for a number of years nothing was done to improve it. The average annual gross income of the Albemarle & Chesapeake Canal for the 14 years, 1886 to 1899, was approximately $81,000. In 1892 the Dismal Swamp Canal was sold and came into the possession of its present owners for a comparatively small sum of money. This new company, called the Lake Drummond Canal & Water Co., improved the Dismal Swamp Canal, reduced the number of locks from 5 to 2, enlarged the channel, and opened the canal to navigation in 1899. From 1901 to 1909 the average annual gross income of the Albemarle & Chesapeake Canal was about $31,000, and the average annual gross income of the Lake Drummond (Dismal Swamp) Canal was about $72,000.

The above statements show that private capital was attracted by the possibility of securing adequate returns for the expenditure necessary to construct a navigable waterway from Norfolk to Albemarle

Sound; that the Albemarle & Chesapeake Canal, commenced in 1856, and opened a few years later, practically destroyed the business of the then existing Dismal Swamp Canal, and that this latter canal when rehabilitated and opened for operation in 1899 reduced the average gross income of its competitor over 60 per cent. These two canals have been built and operated under State charters; each prospered when it was without a competitor; both have felt the effect of competition; neither seems to have sought from the State any redress when part of its business was about to be taken away by the authorization of the construction of a competitor.

The fact that all commerce using either of the two canals from Norfolk to Albemarle Sound was made to pay toll to the owners of the canals, thereby adding to the cost of the carriage of commodities via these routes, early attracted attention to the desirability of a Government-owned free waterway which could be used by this commerce. Under the provisions of several acts of Congress numerous surveys and examinations have been made of the inland waterway from Norfolk to Beaufort and of portions thereof. It is unnecessary to cite all the reports which have been made upon this subject, although it may be well to mention briefly a few of the more important.

In 1875 Congress ordered a survey from the southern end of the Dismal Swamp Canal to the Cape Fear River. The work was assigned to Mr. S. T. Abert, United States civil engineer, and his very able report is to be found in the Annual Report of the Chief of Engineers for 1876, page 376, et seq. This report is valuable, especially for its excellent description of the country through which such an inland waterway must pass. Subsequent to 1875 there were a number of reports, but none of peculiar interest until that submitted by a board of engineer officers in compliance with the provisions of the river and harbor act of 1902, printed as House Document No. 563, Fifty-eighth Congress, second session. By the law the examination made by this board was to determine the most advantageous route for a waterway, with a channel depth not less than 16 feet; the law further directed that the report should include the probable cost of any existing privately owned waterway which might form a part of the proposed route and which it might be to the interest of the United States to acquire in connection therewith. This board considered carefully numerous possible routes, and finally recommended one starting from a point on the southern branch of the Elizabeth River, near Norfolk; thence by a canal across country to the Pasquotank River, N. C., at Cooper Creek; thence via this river to Albemarle Sound.

The Board of Engineers for Rivers and Harbors, in reviewing the above-mentioned report, arrived at the conclusion that the cost of such a waterway was greater than the resulting benefits would justify, but stated that its study of the whole question had resulted in the formation of an opinion that a free waterway, with a depth of 10 to 12 feet, would benefit commerce and would possess military advantages, while probably its cost would be much less than such a waterway with a depth of 16 feet.

Congress subsequently ordered an examination and a report upon such a route with the depth, 10 to 12 feet, recommended by the Board of Engineers for Rivers and Harbors. This work was assigned to a

board of engineer officers, and the report thereof is printed in House Document No. 84, Fifty-ninth Congress, second session.

This report contained estimates of cost for both a 10-foot and a 12-foot channel, but recommended the latter depth, the route to be via the Elizabeth River and the Albemarle & Chesapeake Canal, provided the said canal could be purchased by the United States for a sum no greater than $500,000; otherwise, by a canal across country to the Pasquotank River, substantially the Cooper Creek route mentioned above.

This board further stated that the engineering advantages of the alternate routes were nearly balanced, and that it recommended the adoption of whichever of the two routes would be the less costly to construct. The Board of Engineers for Rivers and Harbors concurred in these recommendations for the 12-foot channel.

By the act of March 2, 1907, Congress provided for the construction of one link in this waterway from Norfolk to Beaufort by appropriating money for the construction of the Adams Creek Canal with a channel depth of 10 feet. It is understood, however, that this canal has been so constructed that there will be no difficulty in the future in giving it a greater depth, if the necessity for so doing becomes apparent.

It is worthy of special note that up to 1909 all reports upon the examinations and surveys of a waterway from Norfolk to Beaufort had, to all intents and purposes, considered this as an independent proposition, and in most, if not all these reports, when the subject of the probable commerce along this route was considered, attention was given mainly to such commerce as would be carried on between Norfolk and points in North Carolina.

In 1909, however, Congress directed a survey for a continuous waterway from Boston, Mass., to Beaufort, N. C., inland where practicable, with a maximum depth of 25 feet, and such lesser depth along any portion as may be found sufficient for commercial, naval, and military purposes. This action by Congress introduces new conditions, and makes the waterway from Norfolk to Albemarle Sound but one link in a continuous intracoastal route. If this section is to serve as part of such a through route it calls for broader and more comprehensive treatment, and there may be warrant for reconsideration of the dimensions and alinement of this waterway, which were deemed adequate when it was regarded as an independent and separate project.

Having considered carefully the part which this particular link of waterway may play in a continuous through route, the board is of the opinion that the specific route selected for the Norfolk-Beaufort section of the intracoastal waterway should be such as will admit future deepening up to 25 feet and that the alinement shall be suited to the future development of a canal of this depth, the minimum radius of curvature to be 2,000 feet, except where local conditions make this impracticable.

The Cooper Creek route having been recommended by a former board, but no survey having been made of this line, the board caused it to be surveyed, and the estimates herein are based upon the results of this field work.

After an examination of all available records the board came to the conclusion that there were but four possible and practicable routes for this waterway worthy of consideration; they are designated

as (1) the Dismal Swamp Canal route; (2) the Albemarle & Chesapeake Canal route; (3) the Cooper Creek route; (4) the new Cooper Creek route. It may be well to state that No. 4 is merely a modification of No. 3, and reaches Pasquotank River a few miles above the mouth of Cooper Creek at the head of Turners Cut, which has already been improved by the Government.

Its investigations have convinced the board that the waterway from the Elizabeth River to Albemarle Sound should be a sea-level canal. Without repeating at length the reasoning upon which this conclusion has been based, unless costly pumping plants be installed, there is no source of water supply which would be adequate for a lock canal with a summit level. The only possible source from which water could be delivered by gravity for a summit-level canal is Lake Drummond, and the amount which can be furnished by this lake is believed to be insufficient to provide for the traffic which would desire to use such a canal. In this connection attention is invited to the discussion of this matter on pages 21, 22, and 23 of House Document No. 563, Fifty-eighth Congress, second session; as bearing upon this question and in line with the facts therein set forth, the latter part of the year 1909 was unusually dry; the total rainfall at Norfolk from September 1, 1909, to December 31, 1909, was only 4.42 inches, which was 9.76 inches below the normal precipitation for the same period. On November 23, 1909, an examination showed that the level of Lake Drummond was then about 16.2 feet above mean low water in the Elizabeth River; that the lake had been drawn down some 7 feet from its highest level, and that its surface elevation was then only about 3.4 feet above the normal level of the existing canal. Subsequent to the date last mentioned the dry weather continued, and it is known that the level of the lake fell still lower. An examination was made again on August 9, 1910; the total rainfall from January 1 to June 30, 1910, was only 1.47 inches below the normal for this period, but during June and July, 1910, a total of 13.23 inches of rain fell, some 3.1 inches above the normal for these two months; on August 9, 1910, the surface elevation of the lake was approximately 19.7 feet above mean low water in the Elizabeth River. Making assumptions similar to those in the public document above mentioned, locks only 300 feet by 60 feet, losses by seepage, leakage, absorption by banks, and evaporation, about 500,000 cubic feet per day, and that shortly after the examination on November 23, 1909, the lake could be drawn down only about 2 feet farther, there would remain in the lake for all uses and losses but about 230,000,000 cubic feet of water, enough to provide for only 40 lockages a day for only about 18 days. This is regarded as a less amount of traffic than would probably seek this route, and the margin is too small to warrant trusting to Lake Drummond as the sole source of water supply for a lock canal, the same conclusion as was reached by the former board. Furthermore, this board believes that, to provide for future developments, the usable length of any locks should be not less than 400 feet, and with locks of such length the consumption of lockage water would of course be greater.

To guard against an interruption to traffic, due to water shortage, it would therefore be necessary to install a pumping plant and to keep it ready for operation; as this is, of course, practicable, an estimate of the cost of a lock canal via this route is given in a table which will be found farther along in this report. Even if the depth

in such a canal is made but 12 feet at first, the lock walls should be carried down far enough to permit future deepening of the canal to at least 16 feet, and the building in which the pumps are placed should be made large enough to accommodate more pumps and more boilers in case the canal is enlarged; the estimates which are given in the table have been made accordingly.

The estimated cost of the waterway by each of the four possible routes is based upon the same dimensions as those used by former boards, as follows:

	Bottom width.	Side slopes.
	Feet.	
In excavations through dry land	90	1–2½
In narrow parts of rivers	125	1–3
In wide portions of rivers, in bays and the entrance to them, and in Currituck Sound	250	1–3
In open sounds and across bars in North River	300	....

Allowance has been made for increasing these widths at bends and for overdepth excavation of 1 foot. The estimates of quantities are based upon place measurement.

The unit prices in this report differ somewhat from those formerly used. They are believed to be conservative and are based upon the most recent experience in the localities where the work must be done. The estimated unit cost for land cuts where in many cases the material must be elevated to considerable heights and where the surface growth must be cleared away, is put at a higher figure than for simple dredging in natural waterways where the material can be pumped or deposited a short distance on either side of the cut and need be raised but little above the natural water surface. The unit prices for land cuts have also been varied in accordance with the relative depth of the cutting below the natural surface of the ground. The calculations of quantities of material are based upon an alignment conforming to that set forth in the sixth paragraph on page 102. The estimates of material to be removed from the Elizabeth River have been revised by omitting all estimates for excavation below the Norfolk & Western Railway bridge, Congress having adopted a project for the improvement of this stream which will provide for a depth of 22 feet up to the said bridge.

No. 1.—*Dismal Swamp Canal route.*

	Length of cuts.	Excavation	Cost of excavation.
Elizabeth River above Norfolk & Western R. R. bridge and Deep Creek, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	4.0	1,375,000	$165,000
12-foot depth	3.5	895,000	107,400
Dismal Swamp Canal to Turners Cut, at 15 cents per cubic yard:			
16-foot depth	23.1	24,520,000	3,678,000
12-foot depth	23.1	19,500,000	2,925,000
Turners Cut and Upper Pasquotank River to Cooper Creek, at 12 cents per cubic yard:			
16-foot depth	8.6	4,030,000	483,600
12-foot depth	8.6	2,800,000	336,000
Lower Pasquotank River to deep water in Albemarle Sound, at 12 cents per cubic yard:			
16-foot depth	21.4	6,300,000	756,000
12-foot depth	17.8	2,026,000	243,120

No. 1.—*Dismal Swamp Canal route*—Continued.

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	36,225,000	25,221,000
Length of cuts (miles)	57.1	47.1
Cost of excavation	$5,082,600	$3,611,520
Right of way	110,000	110,000
Bridges	130,000	130,000
Estimated construction cost	5,322,600	3,851,520
Cost of acquiring canal property	1,750,000	1,750,000
Total estimated cost	7,072,600	5,601,520

(Length of route, 67.6 miles.)

No. 2.—*Albemarle and Chesapeake Canal route.*

	Length of cuts.	Excavation.	Cost of excavation.
Elizabeth River above Norfolk & Western R. R. bridge, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	5.7	2,100,000	$252,000
12-foot depth	5.2	1,400,000	168,000
Virginia Cut, Albemarle and Chesapeake Canal, at 14 cents per cubic yard:			
16-foot depth	8.0	5,200,000	728,000
12-foot depth	8.0	2,890,000	404,600
Upper North Landing River, at 12 cents per cubic yard:			
16-foot depth	10.2	5,300,000	636,000
12-foot depth	10.2	3,710,000	445,200
Lower North Landing River, Currituck Sound, and Coanjock Bay, at 12 cents per cubic yard:			
16-foot depth	17.3	8,000,000	960,000
12-foot depth	17.3	4,200,000	504,000
Carolina Cut, Albemarle and Chesapeake Canal, at 14 cents per cubic yard:			
16-foot depth	3.4	1,112,000	155,680
12-foot depth	3.4	700,000	98,000
North River, at 12 cents per cubic yard:			
16-foot depth	11.5	4,500,000	540,000
12-foot depth	11.5	2,250,000	270,000
North River Bar, at 15 cents per cubic yard:			
16-foot depth	2.8	775,000	116,250
12-foot depth	2.8	350,000	52,500

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	26,987,000	15,500,000
Length of cuts (miles)	58.9	58.4
Guard lock, if necessary	$125,000	$125,000
Cost of excavation	3,387,930	1,942,300
Right of way	36,000	36,000
Bridges	130,000	130,000
Estimated construction cost	3,678,930	2,233,300
Cost of acquiring canal property	500,000	500,000
Total estimated cost	**4,178,930**	**2,733,300**

(Length of route, 68.6 miles.)

No. 3.—*Cooper Creek route.*

	Length of cuts.	Excavation.	Cost of excavation.
Elizabeth River above Norfolk & Western R. R. bridge, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	2.6	600,000	$72,000
12-foot depth	2.3	270,000	32,400
Elizabeth River above Norfolk & Western R. R. bridge, to Pasquotank River, at 15 cents per cubic yard:			
16-foot depth	25.7	27,800,000	4,170,000
12-foot depth	25.7	22,700,000	3,405,000
Pasquotank River to deep water in Albemarle Sound, at 12 cents per cubic yard:			
16-foot depth	26.5	6,300,000	756,000
12-foot depth	22.3	2,026,000	243,120

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	34,700,000	24,996,000
Length of cuts (miles)	54.8	50.3
Cost of excavation	$4,998,000	$3,680,520
Right of way	198,000	198,000
Bridges	130,000	130,000
Total	5,326,000	4,008,520

(Length of route, 62 miles.)

No. 4.—*New Cooper Creek route.*

	Length of cuts.	Excavation.	Cost of excavation.
Elizabeth River above Norfolk & Western R. R. bridge, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	2.6	600,000	$72,000
12-foot depth	2.3	270,000	32,400
Elizabeth River above Norfolk & Western R. R. bridge, to Pasquotank River, at upper end of Turners Cut, at 15 cents per cubic yard:			
16-foot depth	21.4	23,350,000	3,502,500
12-foot depth	21.4	19,300,000	2,895,000
Turners Cut and upper Pasquotank River to Cooper Creek, at 12 cents per cubic yard:			
16-foot depth	9.3	4,030,000	483,600
12-foot depth	9.3	2,800,000	336,000
Lower Pasquotank River to deep water in Albemarle Sound, at 12 cents per cubic yard:			
16-foot depth	26.5	6,300,000	756,000
12-foot depth	22.3	2,026,000	243,120

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	34,280,000	24,396,000
Length of cuts (miles)	59.8	55.3
Cost of excavation	$4,814,100	$3,506,520
Right of way	156,000	156,000
Bridges	130,000	130,000
Total	5,100,100	3,792,520

(Length of route, 64.3 miles.)

Lock Canal via Dismal Swamp route.

	Length of cuts.	Excavation.	Cost of excavation.
Excavation, Elizabeth River and Deep Creek, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	5.7	1,375,000	$165,000
12-foot depth	5.2	895,000	107,400
In canal proper, at 12 cents per cubic yard:			
16-foot depth	22.4	10,100,000	1,212,000
12-foot depth	22.4	6,600,000	792,000
South of canal to deep water in Albemarle Sound, at 12 cents per cubic yard:			
16-foot depth	30.7	10,330,000	1,239,600
12-foot depth	27.1	4,826,000	579,120
Two locks, 400 feet by 60 feet:			
16-foot depth			500,000
12-foot depth			450,000
Pumping plant, 16 and 12 foot depths			75,000
Operating expenses, capitalized at 3 per cent, 16 and 12 foot depths			300,000

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	21,805,000	12,321,000
Length of cuts (miles)	58.8	48.7
Cost of excavation	$2,616,600	$1,478,520
Locks	500,000	450,000
Pumping plant	75,000	75,000
Capitalized operating expenses	300,000	300,000
Right of way	50,000	50,000
Bridges	70,000	70,000
Cost of acquiring canal property	1,750,000	1,750,000
Total	5,361,600	4,173,520

For convenience, the costs of sea-level canals by all four routes are tabulated below:

Costs of sea-level canals.

Route.	16-foot depth.	12-foot depth.
1. Dismal Swamp Canal route	$7,072,600	$5,601,520
2. Albemarle & Chesapeake Canal route	4,178,930	2,733,300
3. Cooper Creek route	5,326,000	4,008,520
4. New Cooper Creek route	5,100,100	3,792,520

In the estimates of the Board no sums are included for revetments or retaining walls on any parts of the routes considered; it is believed to be quite possible that no such works will be necessary, and that it may be found more economical to provide for the maintenance of the waterway by other means; experience alone can settle this matter definitely. As set forth below, the board is of the opinion that the actual cost of maintenance will be substantially the same, no matter what route may be selected, and that the incorporation in its estimates of cost of any sums for maintenance will not effect the relative costs of the waterway by the different routes.

The board has examined with care all available data and all reports upon the differences of elevation of the water surface in the Elizabeth River and in the different bodies of water to the southward

with which this stream might be connected to form the inland waterway to Albemarle Sound. A discussion of this question will be found on page 23, House Document No. 563, Fifty-eighth Congress, second session, wherein it is stated that "the maximum difference of level between the water in Elizabeth River and in Currituck Sound will probably never exceed 11 feet, and this would be produced only by the most extraordinary storm conditions. Under ordinary circumstances this difference would not exceed 4 feet."

If such a difference of level as 11 feet ever did occur, the resulting currents would injure the canal, but this possibility is so remote that the board regards it as hardly necessary to consider it or to provide for it.

Such lesser differences of level up to 4 feet will occur but rarely; they will be produced by southerly storm winds creating an unusually low tide in the Elizabeth River and a piling up of the water at the same time in Currituck Sound, or, by the reverse, a northerly storm with unusually high tide in the river and the blowing out of the water in the sound.

Gauges have been established at the Elizabeth River terminus of the canal, but the period during which readings have been taken is short, nor are there available any recorded readings extending over a sufficient length of time to give reliable data as to the differences of water level in the river and the canal. For the brief period during which the gauges have been read the mean rise and fall of the tide in the river at the Great Bridge lock is about 3 feet, and the mean elevation of the water surface in the canal is about 2 feet above mean low tide.

The distance from the Elizabeth River, at the present Albemarle & Chesapeake Canal lock, to the wide part of North Landing River, which may be considered as the upper end of Currituck Sound, is about 22.6 miles; the board believes that the normal difference between the water levels in the Elizabeth River and the sound will generally be distributed along this length, and that the resulting currents will not be dangerous to the canal, nor will they interfere seriously with navigation.

To provide for abnormal differences of level which may occur at times, there is included in the estimate a sum which will defray the cost of the construction of a tidal guard lock, if subsequent study makes it evident that such a lock will be needed.

The law under which this board is acting distinctly requires a report upon "the probable cost of any private waterway that it may be to the interest of the United States to acquire in connection with the proposed improvement."

The board has secured from both canal companies a statement, in writing, of the price which would be accepted for all of their property. Representatives of the Albemarle & Chesapeake Canal Co. offer to the Government their canal and all their canal property for $500,000; representatives of the Lake Drummond Canal (Dismal Swamp Canal) offer their property for the sum of $1,750,000.

Irrespective of the opinion which the board may have as to the fairness of the above-mentioned prices, these are the sums for which the properties can be obtained, and these sums must be added to the construction cost of the two routes in order that they may be compared and that a comparison may be made between the cost of

a canal by either of these routes and the cost of such a waterway by another route which does not involve the purchase of either of the canal properties.

Relative cost of the waterway by the several routes.—For further comparison, the relative cost of sea-level canals by the several routes is set forth in the table next below, upon a percentage basis, the cost of the waterway via the Albemarle & Chesapeake Canal route in this table being taken as 100.

Route.	16-foot depth.	12-foot depth.
1. Dismal Swamp Canal route	169.2	204.9
2. Albemarle & Chesapeake Canal route	100.0	100.0
3. Cooper Creek route	127.4	146.6
4. New Cooper Creek route	122.0	138.8

ADVANTAGES AND DISADVANTAGES OF THE SEVERAL ROUTES.

The Dismal Swamp Canal route will be, beyond question, the most costly to construct—more costly than either of the Cooper Creek routes, even if all the property of the canal company were ceded to the United States free of charge. The existing canal is not located along the shortest line between its termini, nor on the lowest profile. The material already excavated has been deposited on the immediate banks, and about one-half of it must be moved again on whichever side the enlargement be made. The cost of moving this material is included in the estimate. Its present cross-section is small compared with that which would be necessary in the enlarged canal. Extensive areas along this canal have been reclaimed, and the cost of the right of way may be somewhat greater than the estimate. Former boards, for reasons stated at length in their reports, have rejected this route and apparently have considered it the least practicable of the four.

Many of the residents and land owners on and near the line of the Dismal Swamp Canal have called attention to the fact that, in addition to providing a waterway convenient of access to them, this canal acts as a drain, keeping down the level of the ground water on large tracts of reclaimed land in the Dismal Swamp; they fear that if the Government adopts some other route the Dismal Swamp Canal will be abandoned and they will suffer great damage.

From facts which the board has been able to gather it is thought no such damage can occur. The elevation of the land all along the Dismal Swamp Canal is quite uniform, and there are few variations in its general character. Near the northern end of the canal large tracts of land are now being drained by ditches whose bottoms are at about sea level. Such ditches have been most efficacious, and have greatly improved the lands through which they have been cut. In fact, it has been stated to the board that if the locks of the Dismal Swamp Canal were removed, and if in its then condition it served no other purpose than a drainage ditch, the increased value of the lands which could be drained into it would more than compensate for the loss of the canal as a waterway.

An argument urged in favor of the Dismal Swamp Canal route is that any route which does not follow the Pasquotank River will not

pass directly by Elizabeth City, the largest shipping point in northeastern North Carolina.

As shown above, the cost of a 12-foot canal via the Dismal Swamp Canal route is $2,868,220 greater than via the Albemarle & Chesapeake Canal route. At 3 per cent this sum represents an annual charge of $86,046.60. It becomes a queston whether the local benefit conferred by carrying the waterway directly past Elizabeth City is worth this cost.

Elizabeth City is connected by rail with points north and south. Furthermore, a canal via the Albemarle & Chesapeake route does not cut it off entirely from water communication; it simply makes the water route from Elizabeth City to northern points somewhat longer and less direct. The actual distance from Elizabeth City to Norfolk via the Albemarle & Chesapeake Canal route is about 36 miles longer than by the Dismal Swamp Canal route; but, owing to the greater speed that can be maintained on the former route, the appreciable difference in distance by the two routes may be taken safely at about 30 miles.

The cost for water transportation of bulky freight, which will compose by far the greater portion of the shipments to and from Elizabeth City, can be estimated very liberally at not over 3 mills per ton-mile, so that the actual increased cost of such freight over the longer route will not be more than 9 cents per ton. Through freight rates to and from points south of Elizabeth City will be the same whatever be the route chosen, so that the only freight movement affected by the choice of a route will be that originating at or destined for Elizabeth City.

Tolls at present charged, per ton, on the Dismal Swamp Canal, as taken from the printed tariff, are as follows:

Agricultural implements	$0.75
Canned goods (all kinds)	.40
Flour	.40
Cotton	.60
Coal	.15
Corn	.20
Lumber (about)	.24
Fertilizer	.15
General merchandise	.25

From these figures it is evident that even though freight rates from Elizabeth City to Norfolk via the longer Albemarle & Chespeake Canal route should be increased by as much as 9 cents per ton, yet with a free waterway, and the elimination of the canal tolls, there should be effected a positive saving of from 6 to 66 cents per ton on the carrying charges upon the above commodities between these two points.

At the public hearing in Norfolk on the 6th of September, 1910, it was claimed that the selection of any route which did not pass directly by Elizabeth City would deprive that community of the benefit derived from the existing competition between the waterway and the railroad. The facts stated above seem to have been overlooked. A free waterway via the Albemarle & Chesapeake Canal route should certainly be a more active and efficient competitor with the railroad than the existing toll-charging Dismal Swamp Canal route.

In other words, a free waterway via the Albemarle & Chesapeake Canal route will improve conditions now existing at Elizabeth City, and this town will be much better off than at present, so far as its own water-borne commerce is concerned, meaning thereby commerce originating at or destined for this community. This can hardly be questioned.

The simple fact seems to be that if the Albemarle & Chesapeake Canal route be adopted, Elizabeth City will not be a port of call for through commerce, and to confer such an additional benefit upon this city would cost the United States, even if the cheapest route passing Elizabeth City were adopted, something over $1,059,000 more than it will cost to construct the waterway via the Albemarle & Cheaspeake Canal route, and, furthermore, the opening of the free waterway would be delayed at least three years.

So far as the other small communities lying along the Dismal Swamp Canal are concerned, the abandonment of this canal as a waterway would no doubt impose a hardship upon them, but the amount of commerce involved is quite small, too small to warrant the serious consideration of the purchase and improvement of this route.

This route has heretofore been credited with possessing few, if any, advantages, but there is at least one fact in its favor which seems to have been disregarded or overlooked. If this canal be purchased its operation can be continued without altering the existing locks, while the canal prism is being enlarged, and thus a free waterway, limited it is true to the draft which can now be carried through the locks at either end, will be at once opened to commerce, relieving it of the burden now placed upon it by the canal tolls. It is, of course, apparent that practically all the commerce now using both existing canals would desire to pass through such a free waterway. As shown above, in a season of drought it might be impossible to care for all the traffic which would seek the canal while operated with a summit level, but nevertheless it may be worth while to estimate what the saving to shippers would be in case this canal is made part of a free route, even though there should be some minor interruptions, due to any lack of sufficient water. There is no reason to believe that there would be any diminution in the traffic which normally uses this canal, and every reason to expect that at least 95 per cent of the traffic now plying the Albemarle & Chesapeake Canal would be diverted to this free route.

Statements from the two canal companies show that the average annual gross incomes from tolls for the past few years have been, for the Dismal Swamp Canal, about $72,000; for the Albemarle & Chesapeake Canal about $31,000, an aggregate for both of about $103,000, which would measure the possible annual saving to shippers of goods by a free route, a sum by no means inconsiderable, and which should be taken into account in any discussion as to the route to be recommended for this inland waterway.

To dig an entirely new canal by either of the Cooper Creek routes would take time, probably no less than three years, which would multiply the annual saving to shippers by at least three, and it becomes at once a question whether the Government might not be justified in adopting a route which would be somewhat more costly

when finally completed in order to give this immediate relief to commerce.

Except for the advantages pointed out above—that the canal could be operated while being enlarged, and thereby afford a free waterway at once—this route has no superiority over either of the Cooper Creek routes, and as its cost, when the sum which is asked for the canal property is added to its construction cost, will so far exceed the cost by either of the Cooper Creek routes, it is believed that even the saving to shippers during the time needed to cut a waterway by either of the latter routes would not warrant the recommendation of the Dismal Swamp line.

The Albemarle & Chesapeake Canal route is the longest of the four, being about 1 mile longer than the Dismal Swamp route; it lies nearest to the ocean, and passes for a considerable distance through the open part of Currituck Sound. The 1902 board stated of this portion of the route:

> Here the excavated channel will be exposed to cross winds and currents, and, judging from past experience in maintaining the present channel 9 feet deep, only 2 feet below the natural bottom, the preservation of the deep channel required for the new waterway will not be easy, unless its original width and cost be considerably increased. The canal route passes also across North River bar, another place where the natural depth is small and the deterioration of a dredged cut has been shown to be rapid.

The 1906 board, discussing a waterway only 12 feet deep, seems to have considered the maintenance of such a waterway through Currituck Sound as a matter of no great difficulty.

The controlling depth through this sound was originally 7 feet; prior to 1883 a channel had been secured 9 feet deep, 80 feet wide through the entire length of the upper sound, 10.5 miles, i. e., through the sound proper, north of Coanjock Bay. From 1883 to 1909, 26 years, there had been expended on dredging in this sound only about $28,000, partly in widening the channel and partly in redredging at two localities, near Beacons 5 and 6 and near Long Point. During all this time the Annual Reports of the Chief of Engineers speak of this dredged channel as being in good condition, except for obstructions due to logs, and some little shoaling, which is attributed to steamers grounding outside the channel and creating shoals in their efforts to get off, or to steamers striking the sides of the dredged channels. There is absolutely nothing in any of these reports to indicate any considerable deterioration of this dredged channel; on the contrary, once dredged, it seems to have been maintained remarkably easily and cheaply.

Of course, this dredged channel was of shallow depth, and may be thought to furnish insufficient evidence of what would be the condition of a cut to a depth of 16 feet, or even of 12 feet, but it can be said, at least, that the subsequent behavior of the existing dredged channel through the open part of this sound affords no evidence that any deeper cut would deteriorate rapidly or seriously.

There has been some deterioration of the cut across the North River Bar; this cut was a very narrow one, but 40 feet wide, at first poorly marked, and vessels frequently struck its sides, while there were numerous obstructions, due to sunken logs broken loose from passing rafts.

The board passed through this cut on the 7th of September, 1910, and found in it no depth less than 9.5 feet.

One great advantage possessed by this route is the shorter length of land cut, with its necessarily small cross section; this land cut is only about 14 miles long, against something over 22 miles on the route with the next shortest land cut. The banks along the land cut on this route are but little above sea level, while on all other routes, for long distances, these banks would be about 20 feet above sea level.

Much of this route lies through natural waterways of considerable width; here the improved channel can be made amply large, while the open waters on each side of it will prevent engorgement, and vessels can maintain greater speed, which will more than compensate for the slightly greater length of the route. These facts are especially important when long tows of heavy barges are considered.

The water level through Currituck Sound is subject to considerable fluctuations; winds from the north and east cause depressions of the water surface, sometimes as much as 2 feet; against this there is no way to guard, except by making the waterway sufficiently deeper originally. Interruption to traffic from this cause, however, will not be very frequent, even if no provision is made against it.

An advantage to be gained by adopting the Albemarle & Chesapeake Canal as part of the recommended route would be the same as that pointed out next above—the prompt relief given to existing commerce by providing at once a free waterway which could be operated while its enlargement is in progress.

The Cooper Creek Routes differ but little in location, and not materially in first cost. The line which strikes the Pasquotank River at Cooper Creek avoids a considerable length of crooked river, but the land cut is the longer. The New Cooper Creek route, entering the Pasquotank River at the head of Turners Cut, has a land cut 4.3 miles shorter, but necessitates the use of the crooked natural river channel above Cooper Creek, or the straightening of this channel in many places. Along either of these two lines it will take some years to cut a canal, during which time commerce will still be burdened with canal tolls. On the other hand, both these lines are shorter than either the Dismal Swamp route or the Albemarle and Chesapeake route, and along them there are no existing canal rights to purchase, both decided advantages.

The survey of the Cooper Creek line proper shows that of the total length of the land cut, 25.7 miles, the cutting for a canal 16 feet deep will be 35 feet in depth for 45 per cent of the distance, 30 feet and over for 79 per cent, and 25 feet and over for 89 per cent of the distance. The borings show that the material to be removed along the whole length of the cut will be almost entirely very fine sand, and it is at least possible that there will be difficulty in maintaining the necessary width and depth in such deep cuts.

The board has already expressed its opinion that the waterway from the Elizabeth River to Albemarle Sound should be a sea-level canal, and the estimate made of the cost of a canal with a summit level via the Dismal Swamp Canal shows that for such a canal, 12 feet or more in depth, this cost will be considerably greater than for a sea-level canal by at least one of the other routes.

The representatives of the Dismal Swamp Canal made to the board a proposition to enlarge their existing canal, to provide somewhat larger locks than those now at the ends of the canal, and to turn over this remodeled canal to the United States for the sum of $2,500,000.

Later, upon the request of the board, it was stated that the locks of this remodeled canal would be 50 feet in width, 300 feet in length, with 13 feet of water over the miter sill, the locks to be built of timber up to the perpetual saturation line, and from there up of granite, and the gates of steel; these new locks to be built alongside the old ones, which would be left in place. The exact dimensions of the proposed cross section of the enlarged canal were not given, but it was stated that these dimensions would be governed largely by improvements already made; that the surface width might be 80 to 100 feet, the bottom width 60 to 70 feet, with a minimum of 70 feet where sheet piling has not been placed; the depth would be 12 feet. It was further stated that this enlargement would necessitate the removal of approximately 2,000,000 cubic yards of material, exclusive of the excavation for the locks. All of the board's figures for the cost of locks are based upon lock chambers 400 by 60 feet in the clear, and no smaller dimensions are thought to be sufficient for the future developments of commerce; the board has also fixed 90 feet as the minimum bottom width admissible in this waterway; it regards any dimensions less than these as inadmissible.

It is therefore apparent that the remodeled canal offered by the owners of the Dismal Swamp Canal is much smaller than the minimum considered necessary by the board. Even if the dimensions proposed by the canal company were acceptable, attention is especially invited to the fact that to this cost there must necessarily be added the cost of the improvement of the natural waterways at each end of the canal, leading on the north to the Elizabeth River and on the south to Albemarle Sound. This cost the board now estimates to be for a 12-foot depth $686,520, so that if the above-mentioned offer of the Lake Drummond Canal Company were accepted the total cost of the 12-foot waterway from the Elizabeth River to Albemarle Sound would be approximately $3,200,000, which is about 20 per cent greater than the estimated cost of a sea-level canal of the same depth via the Albemarle & Chesapeake Canal route. The estimates of the cost of improving the natural waterways at the ends of this route have been based upon the dimensions and alignment fixed by the board, and they have been made with care; there is no question of the accuracy of the estimates of quantities of material to be removed. Should it be alleged that the unit prices are too high, to change them would necessitate changing the prices used for similar work on the other routes, leaving the proportionate difference of cost the same. Furthermore, as the board believes that Lake Drummond will not furnish an adequate water supply, there should be added the cost of the installation and operation of a pumping plant and the cost of operating the locks, all of which add materially to the cost of the canal with a summit level.

The river and harbor act of June 25, 1910, contains the following provisions:

> Improving inland waterway from Norfolk, Virginia, to Beaufort Inlet, North Carolina: The Secretary of War is hereby authorized to enter into negotiations for the purchase, as a part of said inland waterway, of the Albemarle and Chesapeake Canal, or the Dismal Swamp Canal, together with all property, rights of property, and franchises appertaining thereto; and he is further authorized, if in his judgment the price is reasonable and satisfactory, to make a contract for the purchase of either of said canals and appurtenances, subject to future ratification and appropriation by Congress: *Provided*, That no contract for the purchase of either of said canals shall be

made unless such purchase, after full hearing of all parties in interest, is recommended in the survey report to be hereafter submitted in compliance with the directions of Congress in the river and harbor act approved March third, nineteen hundred and nine: *Provided further*, That said report shall include estimates of the total cost of the completion of each of said canals, including also the purchase price of each, with the advantages of each for commerce.

At a meeting of the board in Norfolk, Va., on September 6, 1910, there was held a public hearing, which had been widely advertised, and at which there was a "full hearing of all parties in interest;" the report of this hearing accompanies this paper, marked "Appendix E 1."

The estimates of the total cost of the waterway by the different routes include the purchase price of each canal, as fixed by the owners thereof.

The discussion of the different routes herein is believed to give a good idea of the advantages of each of the existing canals for commerce. In addition, it may be stated that, in the opinion of the board, in their present condition of development, the advantages for commerce presented by the Dismal Swamp Canal route are greater than those of the Albemarle & Chesapeake Canal route, but the advantages for commerce presented by a wider and deeper waterway along either route will be so nearly balanced that a choice of route becomes largely a matter of the relative cost.

The cost of a 12-foot canal along the Dismal Swamp route is shown above to be about $2,868,000 more than the cost of a waterway of the same depth via the Albemarle & Chesapeake Canal route, and the board is convinced that the resulting advantages for commerce would not be sufficiently greater to warrant any such larger expenditure of money.

Should it be possible to construct a waterway along an interior route for approximately the same cost as along the Albemarle & Chesapeake Canal route the board would be inclined to give the preference to the former, but the estimates of cost have been made with care, and it is evident that the cost of a 12-foot waterway along the cheapest of the interior routes will be considerably in excess of that of such a waterway along the Albemarle & Chesapeake line.

It is true that the estimated costs of the waterways along these two last-mentioned routes approach each other somewhat more closely as the dimensions of the proposed waterway are increased. The board believes that the depth of 12 feet may be insufficient in the future, and that the cost of future enlargement of the canal should be given due weight in deciding upon a route to be followed, but it is decidedly of the opinion that this depth of 12 feet will be ample for years to come.

The estimated construction cost of such a 12-foot waterway by the cheapest of the interior routes will be some $1,059,000 more than by the Albemarle & Chesapeake route, and, in addition, there will be the annual saving to shippers of about $100,000 by opening at once a free waterway along this last-mentioned route; as stated above, it will take at least three years to construct the interior waterway, which will multiply the annual saving by at least three; adding, then, $300,000 to the estimated excess construction cost gives a total of $1,359,000, a sum which is thought to be much in excess of the actual value of any superior advantages which the interior route may possess.

As bearing upon this question there have been secured from both canal companies statements of their gross income from traffic, by months, for the five years ending December 31, 1909; these figures were not supplied for publication, but in the table following will be found an analysis of them on a percentage basis, which will give an idea of how the commerce through the canals fluctuates from month to month and from season to season.

	Dismal Swamp Canal.	Albemarle & Chesapeake Canal.	Both canals.
Average gross monthly income, 5 years	100	100	100
Same for January, 5 years	98	72	89
Same for February	104	64	91
Same for March	118	93	110
Same for April	120	90	109
Same for May	103	115	107
Same for June	86	136	103
Same for July	80	124	94
Same for August	78	129	95
Same for September	80	100	88
Same for October	108	96	104
Same for November	119	98	112
Same for December	106	83	98
Same for winter months, December, January, February	308	219	278
Same for spring months, March, April May	341	298	326
Same for summer months, June, July, August	244	390	292
Same for fall months, September October, November	307	294	304

An inspection of this table makes it quite evident that the traffic on the Dismal Swamp Canal is greater during the fall, winter, and spring months than during the summer months; on the Albemarle & Chesapeake Canal, the traffic is manifestly less during the winter months than during other seasons of the year.

It does not follow as a matter of course that all of the increase of traffic on the Dismal Swamp Canal during fall, winter, and spring is due entirely to that which is diverted from the Albemarle & Chesapeake Canal by dread of storms and a desire to follow the more sheltered route.

Consideration must be given to the character of this commerce, and of the regions through which these waterways pass; the country tributary to the Dismal Swamp Canal north of Elizabeth City, N. C., is more thickly settled, is capable of much greater agricultural development, and has been much more developed than that along the Albemarle & Chesapeake Canal; according to the best information obtainable, probably about 50 per cent of the total traffic on the Dismal Swamp Canal originates at, or is destined for, Elizabeth City, N. C., and points between there and Norfolk, Va. In the spring and fall months there are considerable outward shipments of truck and of made crops; during the winter there are many ingoing cargoes of fertilizer, and these facts account, in some measure at least, for the greater traffic on this canal during those seasons.

Irrespective of weather conditions, many boatmen now prefer the Dismal Swamp Canal because the mail and telephone facilities are, at present, better than along the other waterway.

Even if some of the existing traffic now prefers the more protected route in the stormy season, it must be remembered that at present the limited channel depth and width confine all commerce to boats of small size; with the greater width and depth now proposed, and

the larger boats which will be used, there will be less danger of interruption by storms on the more exposed waterway, and less reason for seeking the more sheltered route. A study of the existing traffic is believed to furnish no conclusive reason why the United States should be warranted in expending the additional sums set forth in the tables, which it would cost to construct a free waterway via the Dismal Swamp Canal route.

At the public hearing, a representation of the American Association of Masters, Mates, and Pilots, presented resolutions heartily favoring the purchase and improvement of the Dismal Swamp Canal. These resolutions were predicated upon the preference given, at present, by boatmen and shippers to this route, the greater natural resources of the country through which it passes, and its susceptibility to further development, the greater number of points of supply and communication, its asserted greater military advantages, and upon the importance of Elizabeth City, N. C., as a harbor and supply point.

While the opinions of such practical men are worthy of serious consideration, it must not be forgotten that these resolutions favoring the purchase of the Dismal Swamp Canal, rather than the Albemarle & Chesapeake Canal, are based, in part at least, upon the preference now given the former route, losing sight of the fact that if the latter be chosen and improved, conditions will then be decidedly different, and that if the recommendations of the board are approved, the improved waterway via the Albemarle & Chesapeake route will be much superior to the existing one to which the Dismal Swamp route is now preferred. So far as the natural resources of the country are concerned, it is quite probable that the land owners along the Dismal Swamp Canal would be benefited if this route were chosen.

Elizabeth City does offer certain facilities as a harbor and a point of supply and repair, but communications along the improved Albemarle & Chesapeake Canal route will, no doubt, be greatly bettered, the distance is short, and its other advantages are believed to offset the fact that along it, at present, there are no considerable towns.

Certain physical disadvantages which the Albemarle & Chesapeake Canal route has been alleged to possess, have been carefully considered by the board, and all of the more important of these are discussed at some length below.

Although the total length of this route is slightly greater than that of any one of the other three routes considered, yet on account of its greater length of open waterway, it is believed that the time of transit will be somewhat less between termini.

The possible danger of interruption to traffic via the Albemarle & Chesapeake Canal route by the forces of an enemy has been suggested as a reason why this route should not be chosen. At its nearest point this route is distant fully 6½ miles from the seashore, and some 8 miles from the 6-fathom curve in the ocean; the seashore is an open, exposed beach, one where landing is difficult, except in the most favorable weather, off which it is improbable that any vessels can lie for any great length of time. The injury to traffic by this route that could be done by hostile vessels lying offshore is believed to be negligible; the only possible interruption to traffic, in the opinion of the board, is that which might result from the efforts of landing parties, but such an expedition landing from a hostile fleet would probably find it difficult, if not impossible, to bring on shore guns of sufficient range to reach

the canal from any point where they could be located. Furthermore, considering this portion of the waterway as merely one link in a continuous waterway from north to south, there are several other places where such an inland waterway must approach much more closely to the seashore and be more liable to damage and interruption to traffic under conditions much more favorable for an enemy. Again, in the event of war, in order to protect our seacoast defenses from land attack, it is practically certain that we must keep under observation all of our seacoast line between important harbors, and that we must have available a force which could be hurried to any point and which would be adequate to prevent a landing party from doing any damage to this inland waterway.

The naval authorities were asked for an opinion, based upon the use to be made of it by Navy vessels, as to the relative desirability of a waterway via the Albemarle & Chesapeake route, or by a route further inland; after stating that "The most probable use of the inland waterway between Norfolk and Albemarle Sound, as far as the Navy is concerned, would be the transfer of torpedo-boat destroyers, submarines, and smaller vessels, during peace and war," the Acting Secretary of the Navy expresses the opinion that as the distances by the different routes are practically the same, the route further inland is preferred "for the military reason of being more easily defended and less exposed."

In the opinion of the board, the facts set forth above show conclusively that the danger to be anticipated from an attack from vessels at sea, or from landing parties, upon any traffic through the Albemarle & Chesapeake route, is negligible.

Should land forces of an enemy seek to inflict damage upon the waterway, or to interrupt traffic thereon, the much greater length of contracted waterway along the more inland routes renders them more vulnerable, and, furthermore, the character of the country along the Albemarle & Chesapeake route does not favor the operations of land forces, while the country along the inland routes offers much better facilities for the operation, movement, and supply of such forces.

It has heretofore been urged that the cost of maintaining the waterway through Currituck Sound might be excessive. The fallacy of this has been pointed out above, and a recent examination of this channel through Currituck Sound shows that in it there are now no depths less than 9 feet, although no dredging has been done for about four years. This matter is further discussed below.

Cost of maintenance.

	Dismal Swamp Canal route.	Albemarle & Chesapeake Canal route.	Cooper Creek route.	New Cooper Creek route.
	Miles.	*Miles.*	*Miles.*	*Miles.*
Length of land cuts	23.1	14.0	25.7	21.4
Length of cuts in natural waterways of relatively small width	21.2	19.1	5.3	13.5
Length of cuts in natural waterways of relatively great width	22.0	28.9	22.0	22.0

The above table gives some of the physical characteristics of the several routes. While it is impossible to fix, with accuracy, the cost of maintaining a waterway by any of the possible routes, it may be practicable to reach some conclusion as to the relative cost of such work. With such an object in view, compare the Albemarle & Chesapeake Canal and the Dismal Swamp Canal routes; the length of land cuts are, respectively, 14 miles and 23.1 miles, and the vertical height of the banks on the Dismal Swamp Canal line will average some 50 per cent greater than on the Albemarle & Chesapeake Canal line. It would seem fair to assume that the maintenance cost per mile for the former line would be at least one-third greater than for the latter; in other words, the cost of maintaining the 23.1 miles of land cut on the Dismal Swamp Canal route would be no less than the cost of maintaining a cut 30.8 miles long of the character of the land cut on the Albemarle & Chesapeake Canal route.

The cost of maintenance, per mile, in the cutting through narrow natural waterways will quite certainly be no greater than that for a land cut; adding to the Albemarle & Chesapeake land cuts the total length of cutting in such waterways, 19.1 miles, gives an aggregate of 33.1 miles, and it is a very safe assumption that the total cost of maintenance for these parts of the Albemarle & Chesapeake Canal route will be no greater than that on the Dismal Swamp Canal line land cut, plus that for the 5.3 miles in the Elizabeth River.

The remainder of the cutting on this latter line, 30.2 miles, is made up of 8.2 miles in the narrowest part of the Pasquotank River, 6.5 miles in the wider part of this river, and 15.5 miles in its broad estuary below Cobbs Point. The remaining 28.9 miles on the Albemarle & Chesapeake Canal line is made up of 4.5 miles in lower North Landing River, 10.1 miles through Currituck Sound, 11.5 miles in North River, and thence 2.8 miles across North River Bar. North Landing River, 4.5 miles, and North River, 11.5 miles, aggregate 16 miles, and the cost of maintenance for these portions of the route should not differ materially from that for the 8.2 miles in the narrow part of the Pasquotank, plus the 6.5 miles in the same stream between Cooper Creek and Cobbs Point.

This leaves the 10.1 miles in Currituck Sound, and the 2.8 miles across North River Bar on the Albemarle and Chesapeake Canal route, and the 15.5 miles in the estuary of the Pasquotank on the Dismal Swamp route. In the latter body of water, the natural depth is from 10 to 12 feet; in Currituck Sound it is but 7 feet, and through North River Bar there has been some trouble in keeping a very narrow channel open; the exposure in Currituck Sound is also somewhat greater. It may be admitted that, mile for mile, maintenance of the channel through the sound and across the bar will necessitate the annual removal of somewhat greater quantities of material than in the estuary of the Pasquotank, but there is a length of cut in the latter of 15.5 miles, against 12.9 miles through Currituck Sound and across North River Bar.

Moreover, any such work of maintenance will be done best by a Government owned plant; the first cost of such a plant will not differ materially for whichever route it is built; this plant, in all probability, will have to be kept in commission continuously, and if so, the extra cost, if any, of maintaining the waterway via the Albemarle and Chesapeake Canal route, from the above, will be

measured by the greater consumption of fuel and greater wear and tear, due to the removal of somewhat larger quantities of material from the Currituck Sound and North River Bar portions of the Albemarle and Chesapeake Canal route, a sum which can not be very large at the worst, and its expenditure might well be warranted if this route possesses other compensating advantages.

For the above reasons, the board is of the opinion that the relative cost of maintenance is not a deciding factor in the choice of the particular route for this portion of the waterway, since it will be practically the same for all the possible routes.

It has been claimed that vessels navigating Currituck Sound might find difficulty on account of the storms which they would encounter. This objection may be of some weight when the existing narrow channel is considered, but the board's estimate is based upon a bottom width of 250 feet, with comparatively flat side slopes, and, furthermore, it is expected that the excavated material will be placed on the eastward side of this channel, and it is thought that no traffic which seeks this route will be endangered or even greatly incommoded by storms which will be encountered. Again, the total length of the channel in Currituck Sound proper, where the sound widens out and where its width is considerable, is only about 6 or 7 miles, while the depth of the water outside the improved channel will be only about 6 or 7 feet, and storm waves in water so shallow can do little damage to such shipping as will use this route. Furthermore, as noted above, it is intended to deposit the excavated material in a dike some 300 to 600 feet from the eastern side of the channel, and the amount of this material will be sufficient to bring the top of this dike to the water surface, making it an efficient barrier to waves from this, the most exposed, side.

The board has recognized the fact that at times the water surface in Currituck Sound is depressed by the action of the winds, and that this depression may, at times, for short periods, be as much as 2 feet or even a little more. Even if no provision were made to compensate for these occasional depressions of the water surface, the board believes that the interruption to traffic which would seek this route would be inconsiderable, but to guard against even such infrequent interruptions, it is a simple matter to increase the depth of excavation to the needed degree, and this, if done, will not add very considerably to the total cost of the waterway by this route.

After very careful consideration of all the advantages and disadvantages of all the different routes for this section of the waterway, the board recommends that the Albemarle and Chesapeake Canal route be selected and improved by the United States: *Provided*, That all the property and rights of the Albemarle & Chesapeake Canal Co. can be acquired for not exceeding $500,000. The board believes this price to be reasonable, and that it will be to the interest of the United States to acquire this private waterway.

Attention is especially invited to the fact that if the above recommendation of the board be approved, and if the Albemarle and Chesapeake Canal be purchased by the United States, the business of the now competing Dismal Swamp Canal will probably be practically ruined. While it is understood that for such indirect damage done to the canal company it has no legal redress, it is thought proper to invite the attention of Congress to the condition which will then exist.

The board has recommended that the depth in this section of the waterway be fixed, for the present, at 12 feet, for the following reasons:

First. This depth is at least as great as that available at present at all the North Carolina shipping points to and from which practically all the local commerce will be carried.

Second. This depth is greater than that now available in the existing inland waterways south of Norfolk, and will be more than sufficient for such traffic as now passes through them.

Third. This depth will be sufficient for boats and barges much larger than those now in use, and large enough to permit the economical handling and transportation of cargoes of the class which will probably be carried on this waterway.

Fourth. This depth will be sufficient for the smaller vessels of the Navy, torpedo boats, destroyers, and the like, and for many sound, bay, and river steamers which might be used to transport troops and supplies in time of war.

Fifth. If constructed to this depth along the line recommended, this waterway can be deepened readily and economically, if, in future, the needs of commerce justify such an enlargement.

The second division of the proposed intracoastal waterway from Norfolk to Beaufort comprises that portion of the waterway which unites Albemarle and Pamlico Sounds. For this particular link, there are a number of possible routes; one passes through the natural waterway of Croatan Sound; all others, after crossing Albemarle Sound, follow up the Alligator River, and then by land cuts of varying lengths, debouch into Pamlico Sound at different points from near Long Shoal on the east, to the mouth of Pungo River on the west. Each of these alternative routes has been given the name of the locality or waterway where it enters Pamlico Sound; five such possible routes have been considered in previous reports, and they are known as the Long Shoal, Far Creek, Juniper Bay, Rose Bay, and Pungo River routes; in this report an additional route, called the Modified Pungo River route, is also considered.

The survey ordered by the board of the Rose Bay route has been completed; using the data secured, it is now possible to submit an accurate estimate of the quantities of material which it will be necessary to remove along the line surveyed.

In making up these estimates, there have been used the same cross-sections of the waterway as for the Norfolk-Albemarle Sound link, and the same as adopted by former boards.

Croatan Sound route.

	Length of cut.	Excavation.	Cost of excavation.
Croatan Sound, at 20 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	41.0	11,500,000	$2,300,000
12-foot depth	7.5	850,000	170,000
Bluff Shoal, at 12 cents per cubic yard:			
16-foot depth	2.0	600,000	72,000
12-foot depth	.9	111,000	13,320

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	12,100,000	961,000
Length of cuts (miles)	43.0	8.4
Estimated cost	$2,372,000	$183,320

(Length of route, 86.4 miles.)

Long Shoal route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	24.0	7,500,000	$900,000
12-foot depth	19.0	1,950,000	234,000
In swamp, at 14 cents per cubic yard:			
16-foot depth	9.0	4,000,000	560,000
12-foot depth	9.0	3,046,000	426,440
Long Shoal Bay, at 12 cents per cubic yard:			
16-foot depth	9.0	3,000,000	360,000
12-foot depth	6.0	740,000	88,800
Bluff Shoal, at 12 cents per cubic yard:			
16-foot depth	2.0	600,000	72,000
12-foot depth	.9	111,000	13,320

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	15,100,000	5,847,000
Length of cuts (miles)	44.0	34.9
Cost of excavation	$1,892,000	$762,560
Right of way, 800 acres, at $25	20,000	20,000
Harbor of refuge	1,000,000	1,000,000
Estimated cost	2,912,000	1,782,000

(Length of route, 82.5 miles.)

Far Creek route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	24.0	7,500,000	$900,000
12-foot depth	19.0	1,950,000	234,000
Across to shore of Pamlico Sound, at 14 cents per cubic yard:			
16-foot depth	10.2	6,000,000	840,000
12-foot depth	10.2	4,737,000	663,180
Pamlico Sound to deep water, at 12 cents per cubic yard:			
16-foot depth	5.5	1,200,000	144,000
12-foot depth	1.5	591,000	70,920
Bluff Shoal, at 12 cents per cubic yard:			
16-foot depth	2.0	600,000	72,000
12-foot depth	.9	111,000	13,320

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	15,300,000	7,389,000
Length of cuts (miles)	41.7	31.6
Cost of excavation	$1,956,000	$981,420
Right of way, 1,000 acres, at $40	40,000	40,000
Bridges	10,000	10,000
Harbor of refuge	1,000,000	1,000,000
Estimated cost	3,006,000	2,031,420

(Length of route, 75.2 miles.)

Juniper Bay route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River, at 12 cents per cubic yard:	*Miles.*	*Cubic yards.*	
16-foot depth	24.0	7,500,000	$900,000
12-foot depth	19.0	1,950,000	234,000
Across land to head of bay, at 14 cents per cubic yard:			
16-foot depth	22.7	12,000,000	1,680,000
12-foot depth	22.7	7,866,000	1,101,240
Juniper Bay, at 12 cents per cubic yard:			
16-foot depth	8.7	3,200,000	384,000
12-foot depth	4.7	720,000	86,400

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	22,700,000	10,536,000
Length of cuts (miles)	55.4	46.4
Cost of excavation	$2,964,000	$1,421,640
Right of way, 2,100 acres, at $50	105,000	105,000
Bridges	30,000	30,000
Harbor of refuge	1,000,000	1,000,000
Estimated cost	4,099,000	2,556,640

(Length of route, 70.5 miles.)

The above estimates are for the direct line across Lake Hattamuskeet. If a meandering line to the eastward of this lake is adopted, it will be about 5 miles longer and will increase the cost of the land cut by about 22 per cent.

Rose Bay route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River, at 12 cents per cubic yard:	*Miles.*	*Cubic yards.*	
16-foot depth	25.4	7,600,000	$912,000
12-foot depth	18.4	2,750,000	330,000
Across land to shore of Rose Bay, at 14 cents per cubic yard:			
16-foot depth	26.3	15,827,000	2,215,780
12-foot depth	26.3	11,991,000	1,678,740
Rose Bay, at 12 cents per cubic yard:			
16-foot depth	4.1	1,500,000	180,000
12-foot depth	3.9	617,000	74,040

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	24,927,000	15,358,000
Length of cuts (miles)	55.8	48.6
Cost of excavation	$3,307,780	$2,082,780
Right of way, 2,600 acres, at $40	104,000	104,000
Bridges	30,000	30,000
Estimated cost	3,441,780	2,216,780

(Length of route, 80.5 miles.)

Pungo River route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River to common point, at 12 cents per cubic yard:	*Miles.*	*Cubic yards.*	
16-foot depth	24.0	7,500,000	$900,000
12-foot depth	19.0	1,950,000	234,000
Upper part of Alligator River, at 12 cents per cubic yard:			
16-foot depth	7.0	3,000,000	360,000
12-foot depth	7.0	420,000	50,400
Land cut to Pungo River, at 14 cents per cubic yard:			
16-foot depth	21.3	12,750,000	1,785,000
12-foot depth	21.3	7,930,000	1,110,200
Pungo River, at 12 cents per cubic yard:			
16-foot depth	5.5	1,000,000	120,000
12-foot depth	1.0	160,000	19,200

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	24,250,000	10,460,000
Length of cuts (miles)	57.8	48.3
Cost of excavation	$3,165,000	$1,413,800
Right of way, 2,300 acres, at $40	92,000	92,000
Bridges	30,000	30,000
Estimated cost	3,287,000	1,535,800

(Length of route, 96.4 miles.)

Modified Pungo River route.

	Length of cut.	Excavation.	Cost of excavation.
Alligator River to common point, at 12 cents per cubic yard:	*Miles.*	*Cubic yds.*	
16-foot depth	24.0	7,500,000	$900,000
12-foot depth	19.0	1,950,000	234,000
Land cut to Pungo River, at 14 cents per cubic yard:			
16-foot depth	26.0	16,000,000	2,240,000
12-foot depth	26.0	12,100,000	1,694,000
Pungo River, at 12 cents per cubic yard:			
16-foot depth	5.5	1,000,000	120,000
12-foot depth	1.0	160,000	19,200

RECAPITULATION.

	16-foot depth.	12-foot depth.
Excavation (cubic yards)	24,500,000	14,210,000
Length of cuts (miles)	55.5	46.0
Cost of excavation	$3,260,000	$1,947,200
Right of way	100,000	100,000
Bridges	30,000	30,000
Estimated cost	3,390,000	2,077,200

(Length of route, 94 miles.)

Comparison of different routes.

Name of route.	16-foot depth.				12-foot depth.		
	Length of route.	Length of land cuts.	Length of cuts in natural waterways.	Cost.	Length of land cuts.	Length of cuts in natural waterways.	Cost.
	Miles.	*Miles.*	*Miles.*		*Miles.*	*Miles.*	
Croatan Sound	86.4	0.0	43.0	$2,372,000	0.0	8.4	$183,320
Long Shoal	82.5	9.0	35.0	[1] 2,912,000	9.0	25.9	[1] 1,782,560
Far Creek	75.2	10.2	31.5	[1] 3,006,000	10.2	21.4	[1] 2,031,420
Juniper Bay	70.5	22.7	32.7	[1] 4,099,000	22.7	23.7	[1] 2,556,640
Rose Bay	80.5	26.3	29.5	3,441,780	26.3	22.3	2,216,780
Pungo River	96.4	21.3	36.5	[2] 3,287,000	21.3	27.0	[2] 1,535,800
Modified Pungo River	94.0	26.0	29.5	3,390,000	26.0	20.0	2,077,200

[1] To construction cost has been added $1,000,000, estimated cost of necessary harbor of refuge at Pamlico Sound entrance.
[2] Quantities taken from report of former board. No survey ever made of this route. Quantities and total estimated cost believed to be too small.

Except the accurate data secured by the recent survey of the Rose Bay route and of the Modified Pungo River route, it has been possible to secure but little information in addition to that set forth in the reports of former boards.

An inspection of the table next above shows a wide discrepancy between the first cost of a 12-foot waterway via Croatan Sound and the cost of a similar waterway via any one of the other possible routes. This discrepancy is not nearly so marked where the greater depth of 16 feet is considered. The board believes that future development may necessitate deepening the waterway to at least 16 feet and that the relative costs of the different routes for such greater depths should have some bearing upon the choice of route; it also believes that the manifest disadvantages of the Croatan Sound route even for a depth of 12 feet as set forth below, warrant its rejection and the recommendation of a route whose first cost is much greater.

Croatan Sound route.—Croatan Sound lies between Roanoke Island and the mainland; it has an average width of about 3 miles; its bottom is very irregular, there being depths as great as 6 fathoms, but no continuous channel with a depth greater than 9 feet. There are no lunar tides in this sound, but there are currents, sometimes in one direction, sometimes in the other, due to the fluctuations caused by winds in the large bodies of water which it connects. The bottom of this sound is sandy, and, while few marked changes, due to natural causes, seem to take place in the existing channel, there is some evidence that where artificial channels are dredged nature tends to obliterate such channels quickly and to restore the bottom to its original condition. Both the 1903 and the 1906 boards cite the fact that in 1901 a cut was made near Croatan Light, 200 feet wide and 12 feet deep, where the natural central depth was but 10 feet, and that shortly thereafter no trace could be found of this dredging; for a 16-foot waterway through this sound, dredging would have to be done for a length of over 40 miles, and if similar shoaling of the dredged cut did take place the maintenance of such a waterway would be very difficult and costly. From the southern end of Croatan Sound the route passes through the broad waters of

Pamlico Sound, where storms of considerable severity are not infrequent. It also must cross Bluff Shoal, on which the natural depth at the crossing is not over 11 feet, and the distance between 16-foot contours about 2 miles. Such a cut will be in an exposed location and may require frequent redredging for its maintenance.

The Long Shoal and Far Creek routes differ but little in cost, length of land cut, and in physical characteristics. Following either of these routes it is necessary to cross Bluff Shoal, as set forth for the route next above. Except near the entrance to Pamlico Sound and at the Bluff Shoal crossing the maintenance of the waterway by either of these two routes will be easy and inexpensive. It is thought that a dredged channel in Alligator River, where it is well sheltered and where there are practically no currents, will suffer but little deterioration; the elevation of the banks of the land cuts will be but little above the water level, and the maintenance of these cuts will probably involve but little subsequent work.

At the Pamlico Sound ends of these routes there are no natural harbors, no shelter for vessels from the severe storms that sweep over this sound, and if either of these routes be chosen it will be necessary to provide a harbor of refuge, the cost of which will be great, and this should be taken into consideration in any estimate of the total cost of the waterway via either of these routes. The 1903 board roughly estimated the cost of such a harbor of refuge at $1,000,000, and this estimate has been retained in the tables preceding.

The Juniper Bay route.—Without a considerable detour to the eastward, which will add to its length and cost, this route must cross Lake Mattamuskeet. It is known that plans have been made for draining this lake and the country immediately adjacent thereto, and it is very probable that these plans will be carried out in the near future. A canal across the lake will interfere seriously with them, and with the elaborate system of drainage ditches will necessitate the establishment and maintenance of additional pumping stations, and it may be well to avoid carrying the waterway across this drainage district, even at a somewhat greater first cost for excavation and at some sacrifice of directness of route. This route passes into Pamlico Sound through Juniper Bay, the entrance to which is quite open and exposed to the southeast, whence come the most violent storms, though not the storms of longest duration. This route and those subsequently mentioned avoid the Bluff Shoal crossing.

The Rose Bay route.—The direct line for this route crosses Lake Mattamuskeet, but for the reasons above given it was thought best to carry the survey on a slightly longer meandering line to the westward of the lake and the proposed drainage district. Rose Bay is well protected from storms; the deep water of the sound makes well up in the bay; there is thus formed a harbor with fair depth and area, both of which can be readily increased if necessary. The rest of the route from Rose Bay to Adams Creek (which has already been adopted as part of this waterway) is comparatively sheltered. Rose Bay is also near the mouth of the Pamlico River and not far distant from the shipping points located thereon.

This route runs through a country part of which is fairly well timbered, and all of which is said to be quite fertile. Its isolation

and lack of ready access to markets have prevented its development. A waterway via this route would probably increase greatly the value of the adjacent land and stimulate the development of all its natural resources.

The Pungo River route.—This route, described by the 1906 board, leaves Alligator River at a point farther upstream than the Rose Bay line and then runs across country to the Pungo River. It offers advantages similar to those on the Rose Bay route; the harbor in Pungo River is larger and even more sheltered, and a railroad reaches this stream at a point convenient to the water route, but the distance via this water route is some 15 miles greater than via the surveyed Rose Bay line. No survey of the Pungo River line has ever been made; the quantities of materials were calculated by the 1906 board from such maps of this region as were available, and, for accurate computations, the data supplied by these maps is not sufficient. The board believes that the estimate of cost of this route in the preceding tables, based upon the quantities calculated by the 1906 board, is probably too small, and that even if the cost of this line should be somewhat less than that of the Rose Bay route, this latter and much shorter route is decidedly preferable.

Modified Pungo River route.—From a point on the Rose Bay surveyed line a survey was made of a line to Pungo River, furnishing a basis for an accurate estimate of the quantities of materials to be removed along a practicable route from Alligator River to Pungo River. A waterway 12 feet deep along this line would cost about $140,000 less than along the Rose Bay line, but it would be some 13.5 miles longer, and the shorter, though slightly more expensive, route is given the preference.

Route recommended.—After a thorough study of the relative advantages and disadvantages of all the possible routes, the board recommends that the Rose Bay route be adopted for this portion of the waterway joining Albemarle and Pamlico Sounds, and that, in accordance with its recommendation for the first section of the waterway from Norfolk to Beaufort, the depth along this route be made 12 feet at mean low water for the present.

The cost of such a 12-foot waterway via the Rose Bay route is estimated, as above, at $2,216,780. This sum is very largely in excess of the estimated first cost, $183,320, of such a waterway through Croatan Sound, but the board believes that the reasons set forth fully justify it in recommending a route whose first cost is so much greater.

On this portion of the through route the cost of maintenance becomes a matter of decided importance. Considering first the Rose Bay route, that portion which lies in Alligator River, some 24 miles, will require but little deepening to give the 12-foot depth; in this river the currents are slight, the protection from storms is excellent, and once the channel is excavated, there is every reason to expect that it can be maintained for a merely nominal annual expenditure; the land cut, some 26 miles in length, passes through a comparatively level and low-lying country where the maximum height of the surface is but about 8 feet above mean low-water level; the vertical height of the canal banks will not be great; the borings indicate that the material which will be encountered in excavating

will be mainly sand, and it is thought that the banks will soon take a slope which will be quite permanent, and that thereafter the cost of maintenance will be but a small sum annually.

In Croatan Sound conditions are quite the reverse; here all the available evidence goes to show the decided instability of dredged cuts; it is known that there are here currents of considerable strength, sometimes in one direction, sometimes in the other; it is known that a dredged channel but 2 feet deeper than the natural depth was obliterated in a short time. This channel was dug in 1901; when next examined, five years later, no trace of it could be found. If the rate of deterioration thus indicated should exist in other dredged channels, and there is no reason to doubt that it will do so, the annual cost of maintenance will probably represent a capital sum which will largely, if not entirely, offset the lesser first cost of this route compared with the Rose Bay route. The length of the dredged channel through Croatan Sound for greater depths than 12 feet increases rapidly, and for a depth of 16 feet the length of dredged channel would be in excess of 40 miles, and it seems probable that practically continouus dredging would be necessary to maintain in such a channel its proper dimensions.

The Croatan Sound route makes necessary the crossing of Bluff Shoal and the dredging of a channel practically 1 mile long between 12-foot contours. Considering its exposure and the well-known violence of the storms in Pamlico Sound, the maintenance of such a channel across this shoal would be a matter of difficulty. The Croatan Sound route compels all shipping to traverse the entire length of Pamlico Sound, and at its widest part the route must pass through the middle of the Sound. As indicated above, the storms in Pamlico Sound are quite severe, and the exposure of shipping via this route would be great, while there is no intermediate harbor where vessels could take refuge in stormy weather.

The Rose Bay route avoids the Bluff Shoal crossing entirely, and, being practically an inland route all the way, there is no danger at all from storms, while in the Alligator River at the north end and in Rose Bay at the south end there are excellent natural harbors.

Along the Croatan Sound route the local traffic will be practically nothing—there are no shipping points—nor will this route open up any new country. The Rose Bay route will pass directly through an undeveloped country, but one which is said to be naturally very rich, and which will develop rapidly as soon as transportation routes are opened.

FROM PAMLICO SOUND TO BEAUFORT INLET.

No matter what route be followed to Pamlico Sound, the route thence to Beaufort Inlet has already been fixed by the adoption by Congress of the Adams Creek route from the Neuse River southward and the canal along this route has been excavated to a depth of 10 feet at mean low water, the depth fixed by the law providing for its construction, but the board recommends that it be deepened to 12 feet at mean low water.

Assuming that the Rose Bay route to Pamlico Sound be adopted as recommended above, the board further recommends that from Rose Bay to Adams Creek the waterway be carried across Bran

Shoal, which will shorten the distance by about 12 miles, and will necessitate the following work:

Brant Shoal.	Length of cuts.	Excavation.	Cost of excavation.
	Miles.	*Cu. yds.*	
16-foot depth	2.1	850,000	$127,500
12-foot depth	1.0	360,000	54,000

This cut across Brant Shoal being quite short and in sheltered waters can probably be maintained without any great expense.

From Neuse River to Beaufort the route via Adams and Core Creeks has already been selected, and this link in the waterway has been completed with a depth of 10 feet. No further discussion or recommendation as to the location of this portion of the route is necessary.

The cost of deepening the Adams Creek Canal to 12 feet at mean low water, as ascertained from the officer in charge, is estimated at $207,500, and of the additional work necessary to give the same depth to Beaufort Inlet at $190,000.

The following table sets forth the total cost of the waterway from Norfolk to Beaufort along the recommended route:

	16-foot depth.	12-foot depth.
Norfolk to Albemarle Sound, Albemarle and Chesapeake Canal route	$4,178,930	$2,733,300
Albemarle Sound to Pamlico Sound, Rose Bay route	3,441,780	2,216,780
Brant Shoal Cut	127,500	54,000
Pamlico Sound to Beaufort Inlet, via Adams Creek Canal		397,500
Total for 12-foot depth		5,401,580

As the estimates and recommendations of the board for the remainder of the route from Norfolk to Beaufort are based upon a minimum depth of 12 feet, the board strongly recommends that the Adams Creek Canal be deepened to this same depth, and that this depth be carried further to Beaufort Inlet at the estimated cost given in the table next above.

Commercial necessity.—The commercial importance of an inland waterway from Norfolk, Va., to Beaufort, N. C., has been discussed at great length in former reports, and in the report published in House Document No. 563, Fifty-eighth Congress, second session, there appear many communications from commerical bodies and others interested, in which are set forth in detail various estimates of the amount of commerce which would be benefited by such a waterway and of the actual saving in freight rates and insurance which would follow its completion.

In all previous discussions this portion of the inland waterway has been considered as a separate, concrete proposition, but now its importance is enhanced by reason of the possible development of free inland waterways extending north and south from its termini.

As has been pointed out many times, this portion of the inland waterway will enable the boats which will ply upon it to avoid the dan-

gers of the outside passage around Capes Hatteras and Lookout, dangers which have a decided effect upon the rates now charged for freight and insurance between north and south Atlantic ports.

Although freight in large quantities is now carried in barges between many points on the Atlantic coast north of Cape Hatteras, where the distances between harbors which can afford shelter in stormy weather are comparatively short, yet owing to the difficulties and dangers of Cape Hatteras and Cape Lookout, and to the fact that there is no safe harbor for many miles south of the entrance to Chesapeake Bay, all attempts to introduce the barge system on the south Atlantic coast have been unsuccessful. There is some reason to believe, however, that the opening of the inland waterway, avoiding the most dangerous portion of the coast, would shortly be followed by an extension of the barge method of transportation to and from south Atlantic ports, and by a resulting decrease in freight and insurance charges.

There is already a considerable commerce in barges from Norfolk and points to the southward, some of which passes out of Chesapeake Bay, while some goes through to Philadelphia by the existing inland route. The draft and the carrying capacity of such barges as now use the inland routes are limited by the available depth therein, while this commerce is also hampered by the toll charges on the privately-owned canals forming portions thereof. With free inland waterways with greater depth than now exists there is every reason to believe that this commerce would be greatly stimulated, and that it would soon show a substantial increase.

The country through which such a waterway south of Norfolk will pass is largely undeveloped, although its natural resources are great, and it is capable of being made highly productive. Within the area which would be tributary to this waterway there is still much standing timber; it is understood that many of the owners of timbered lands are now conserving their forests, and that they expect them to yield considerable quantities of lumber for many years to come. Much of the land adjacent to this proposed waterway is admirably adapted for truck and fruit; it is expected that the opening of the water route will stimulate these industries and that such produce can be transported economically by water to northern markets in small vessels or in barges equipped, if necessary, with refrigerating plants.

While the opening of the Norfolk-Beaufort link in the inland waterway would no doubt result in a very substantial saving in freight charges, just what would be the amount of such saving it is not so easy to predict. The board has examined with care all the statements heretofore submitted by commercial bodies and others and has checked the figures given therein as thoroughly as possible. After a study of these statistics, the 1902 board estimated that the annual saving in freight charges on "through" freight which would be carried between the termini of this portion of the waterway would probably not be less than $600,000. In view of the possible development of free inland waterways north and south of the Norfolk-Beaufort section, the board believes this estimate of the probable saving to be a conservative one.

It has been shown above that the existing commerce, although handicapped by the small depth in the canals south of Norfolk, actually pays in tolls to the owners of these canals no less than $100,000

annually. Making free the waterway between Norfolk and Albemarle Sound will result in saving this sum at once, while if this free waterway is given the dimensions recommended herein, there seems to be no doubt that there will be a substantial increase in this commerce and that the actual saving may be, at the least calculation, twice the amount now paid in tolls, or some $200,000.

An annual saving of this sum capitalized at 3 per cent would amount to over $6,000,000, about twice the estimated cost of constructing that portion of the waterway which will connect the Elizabeth River at Norfolk with Albemarle Sound and considerably more than the estimated cost of the entire waterway from Norfolk to Beaufort.

Add to this almost certain annual saving any saving which might be effected on through freight which would follow this route in preference to taking the outside passage around the Capes and also any saving on the local traffic which would be developed along the waterway south of Albemarle Sound, and it seems certain that the resulting total benefit to commerce will be enough to warrant the statement that as a mere business proposition the construction of the inland waterway from Norfolk to Beaufort is fully justified.

The military importance of such a waterway likewise has been the subject of numerous reports. It will furnish a ready means for the transport of troops and supplies along a portion of the seacoast and a sheltered interior route for torpedo boats, destroyers, and submarines.

Considering the moderate cost and the probable commercial and military importance of such an inland waterway, the board is of the opinion that its construction is worthy of being undertaken by the United States, and it recommends that it be constructed along the route specified above.

As it is proposed to make this portion of the waterway sea level, no questions of water-power development enter into this discussion.

At Norfolk, the northern terminus of this section of the waterway, there are ample facilities for the transfer of freight between cars and boats and, while there are no public wharves at present, the building of such wharves is being discussed, and it is possible that their construction may be undertaken.

Respectfully submitted.

W. M. Black,
Colonel, Corps of Engineers, United States Army.

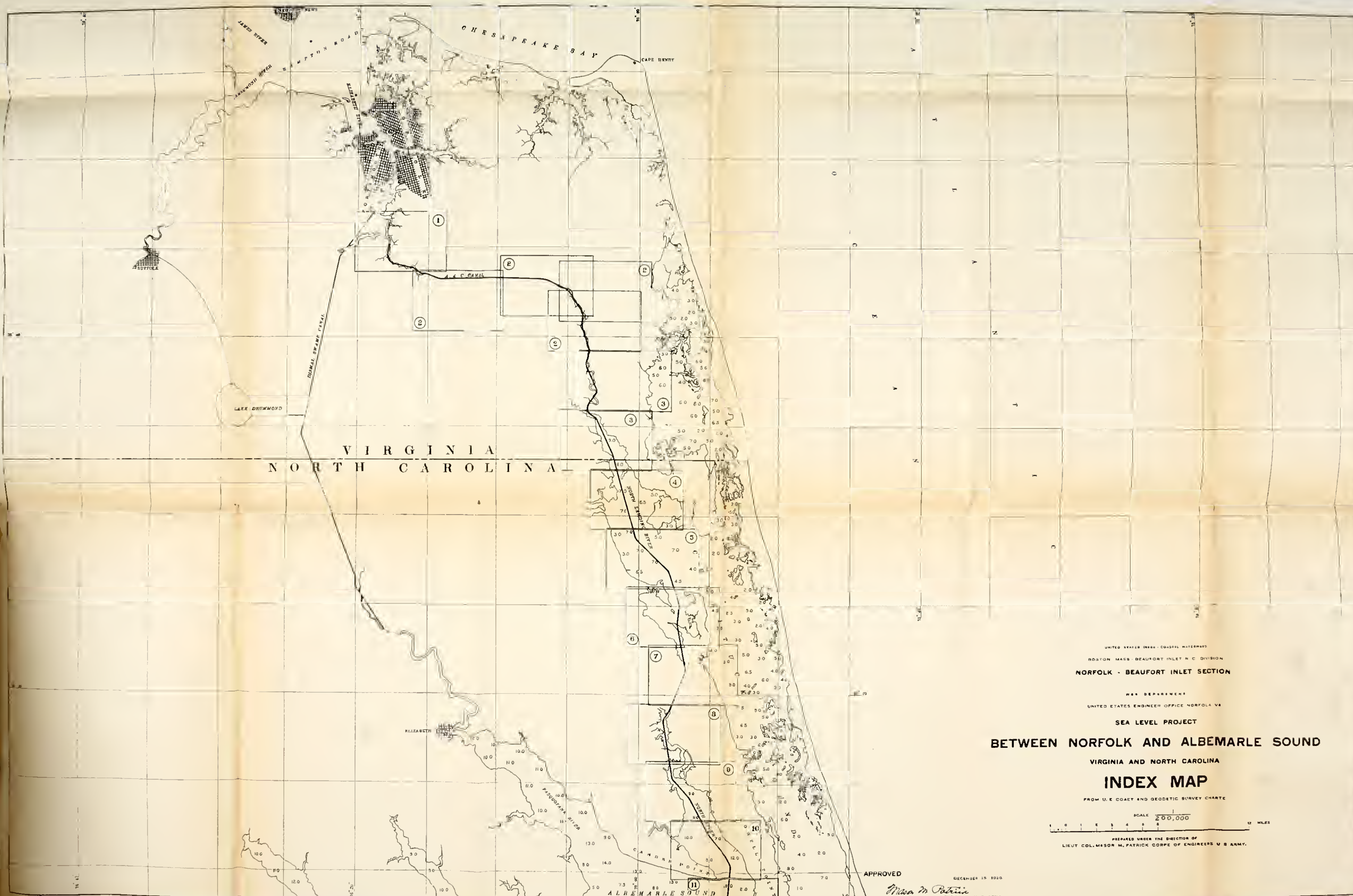
Frederic V. Abbot,
Colonel, Corps of Engineers, United States Army.

J. C. Sanford,
Lieut. Col., Corps of Engineers, United States Army.

Mason M. Patrick,
Lieut. Col., Corps of Engineers, United States Army.

R. R. Raymond,
Major, Corps of Engineers, United States Army.

The Chief of Engineers, United States Army.



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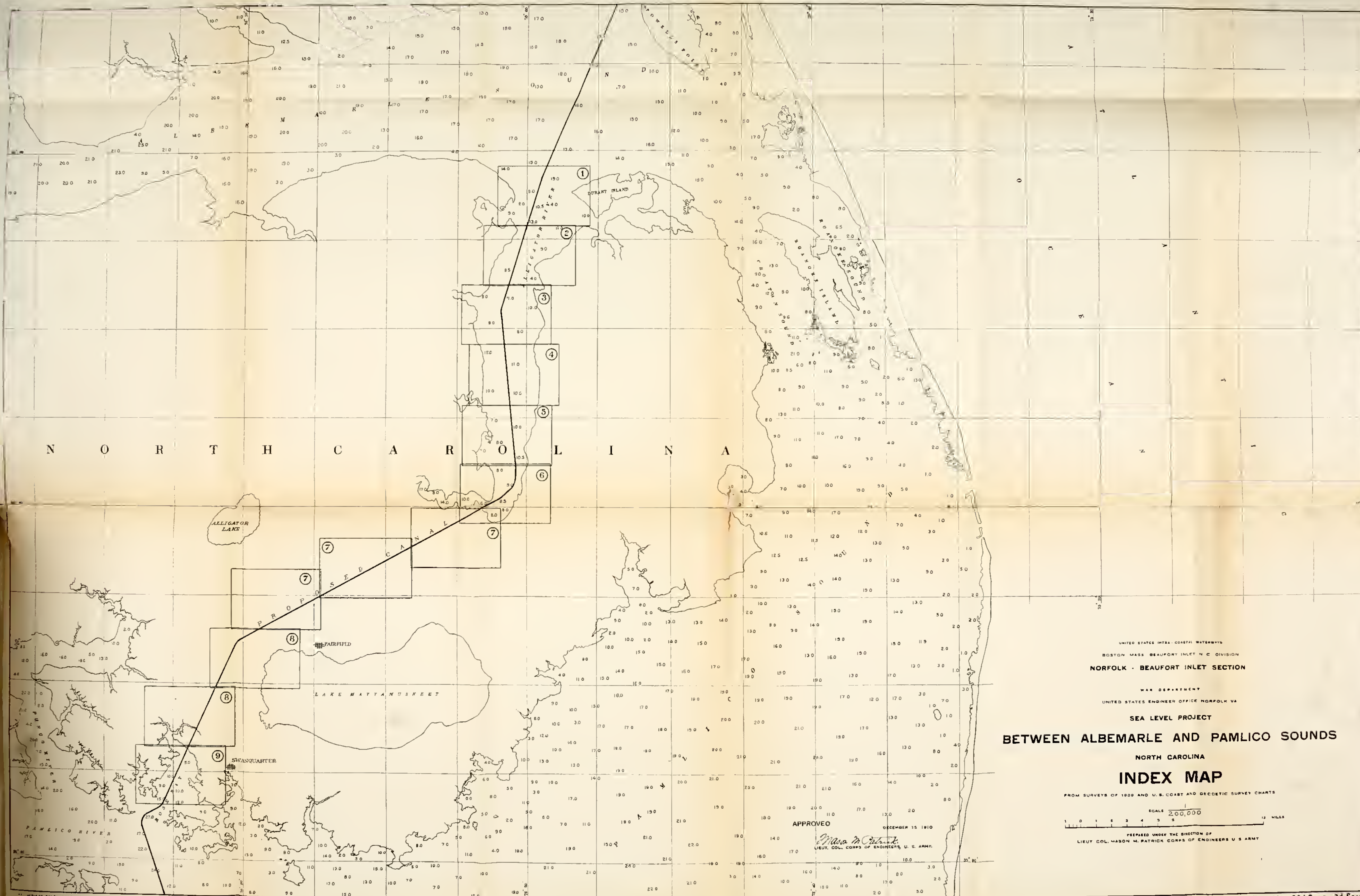
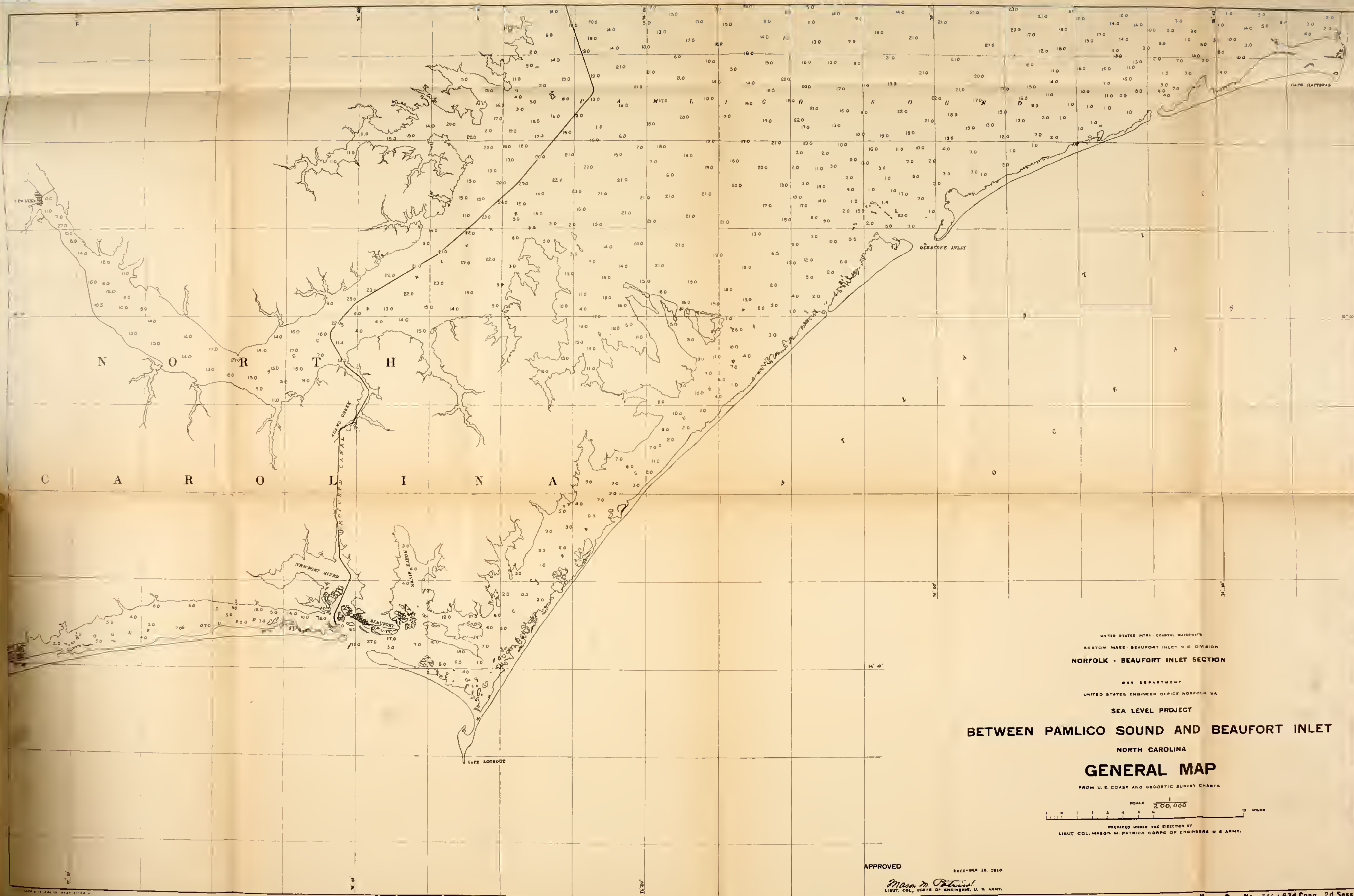


House Doc. No. 371, 62d Cong., 2d Sess



House Doc. No. 311 ; 62d Cong., 2d Sess.

INDEX OF APPENDIXES TO ACCOMPANY REPORT ON BOSTON-BEAUFORT INLET DIVISION, PROPOSED INTRACOASTAL WATERWAY, DATED OCTOBER 4, 1911.

[Appendix A 1.]

REPORT OF THE COMMISSION ON INLAND WATERWAYS ON A FREE SHIP CANAL CONNECTING BOSTON AND NARRAGANSETT BAY.

[According to Chapter 26, Resolves of 1911, May 1, 1911.]

THE COMMONWEALTH OF MASSACHUSETTS,
SENATE,
February 28, 1911.

The committee on harbors and public lands, to whom was referred so much of the governor's address (Senate, No. 1) concerning transportation as relates to the development of the internal waterways of the State, report the accompanying resolve.

For the committee.

GEORGE HOLDEN TINKHAM.

RESOLVE TO PROVIDE FOR THE APPOINTMENT OF A COMMISSION TO CONSIDER IN WHAT MANNER THE COMMONWEALTH MAY BEST COOPERATE WITH THE FEDERAL GOVERNMENT AND CERTAIN OTHER STATES IN THE DEVELOPMENT OF INLAND WATERWAYS.

Resolved, That the governor, with the advice and consent of the council, shall within 30 days after the passage of this resolve appoint a commission consisting of seven persons, citizens of the Commonwealth, one of whom he shall designate as chairman—

To consider in what manner the Commonwealth of Massachusetts may best cooperate with the Federal Government in the construction of a ship canal—free and open to the commerce of the world and without tolls or charges for the passage of freight thereon—across the State as now being surveyed by the Engineers of the United States War Department, under the provisions of section 13 of the rivers and harbors act approved March 3, 1909; the same being a link of the proposed Intracoastal Waterway between Boston and the Rio Grande in Texas, and in harmony with the plan advocated by the Atlantic Deeper Waterways Association;

To consider how best the Commonwealth may cooperate with other States along the Atlantic seaboard—more especially Rhode Island—in the development of these inland waterways;

To consider the value of such a canal to the State and its inhabitants in the development of industries, the reduction in the cost of handling raw material and manufactured products or otherwise, and the benefit to transportation generally along the Altantic coast.

The commission shall serve without pay. The commission shall report in print to the general court on or before May 1, 1911.

THE COMMONWEALTH OF MASSACHUSETTS,
Boston, May 1, 1911.

To the Great and General Court of the Commonwealth of Massachusetts:

The commission on inland waterways appointed by the governor in accordance with the resolve of the legislature 1911, senate No. 362, has the honor to report:

The resolve limits the duties of the commission to the consideration of a free ship canal to be constructed and maintained by the Federal Government, connecting Boston and Narragansett Bay, as now being surveyed by the Engineers of the United States Army. This proposed canal is the northern one of a proposed system of intracoastal waterways advocated by the Atlantic Deeper Waterways Association. The rivers and harbors act approved March 3, 1909, authorized and appropriated for surveys of these intracoastal waterways in the following terms:

"Survey for the construction of a continuous waterway inland where practicable from Boston, Mass., to Long Island Sound, including a waterway from the protected waters of Narragansett Bay through the ponds and lagoons lying along the southern coast of Rhode Island to Watch Hill and Fishers Island" * * * "to the sounds of North Carolina and Beaufort Inlet, N. C." * * * "with a maximum depth of 25 feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of

plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same." * * * "*Provided*, That whenever, in the making of a survey of any of the preceding waterways, field work shall indicate that the proposed improvement is clearly inadvisable no detailed survey or plans shall be made."

Under this act the Chief of Engineers made an allotment from the general appropriation of $40,000 for the cost of the survey of the canal from Boston to Narragansett Bay, and the work has been performed by Lieut. Col. F. V. Abbot, Corps of Engineers, district engineer of Boston, through whose courtesy and by authority of the Chief of Engineers of the United States Army, the commission has been furnished with full information.

THE INTRACOASTAL WATERWAYS SYSTEM.

The intracoastal waterways as now projected consist of the following canals:

Boston, Mass., to Narragansett Bay.

Narragansett Bay to Watch Hill.

Raritan River to Delaware River.

Delaware River to Chesapeake Bay.

Norfolk, Va., to the sounds of North Carolina and Beaufort Inlet.

These canals are to be surveyed for a maximum depth of 25 feet or such lesser depths along any section as may be found sufficient for commercial, naval, or military purposes.

Beaufort, N. C., to the Cape Fear River.

Cape Fear River to Winyah Bay, S. C.

Winyah Bay to St. Johns River, Fla.

St. Johns River to Key West, Fla.

These canals from Beaufort, S. C., are to be surveyed for a maximum depth of 12 feet or such lesser depths along any section as may be found sufficient for commercial, naval, or military purposes.

A canal across the State of Florida between suitable points on the eastern and the Gulf coasts of 12 feet or lesser depth.

A survey is also authorized for the construction of a continuous waterway inland where practicable along the Gulf of Mexico from St. Georges Sound to the Mississippi River at New Orleans and from thence to the Rio Grande. The Gulf inland canals are to be surveyed for a maximum depth of 9 feet or such lesser depths as may be recommended.

THE BOSTON-NARRAGANSETT BAY CANAL.

The Army Engineers in preparing the project for the Boston-Narragansett Bay Canal have made surveys of approximately seven different routes between the Taunton River and Boston Harbor and by elimination of the routes where a practicable location was not to be found have now limited their choice to two routes—one from Taunton River to Plymouth Harbor, and the other from the Taunton River into Boston Harbor near Hingham. (See inserted plan.)

The general features of the canal project common to all the estimates which have been prepared are based on having no curves of less than 2,200-foot radius; the side slopes are 1 rise to 2 base and are to be protected against wash. The locks are to be 80 feet wide in the clear and 500 feet long in the clear. In each case estimates have been prepared for bottom widths of 125 feet and 200 feet and a depth of water of 18 feet and 25 feet. (See p. 32.)

For a ship canal, both a bottom width of 125 feet and a depth of 18 feet are inadmissible, and, therefore, the commission confines itself to a consideration of the surveys and estimates for a 25-foot depth canal, 200 feet bottom width.

DESCRIPTION OF TAUNTON-PLYMOUTH ROUTE.

On the Taunton-Plymouth route a sea-level cut is possible and the estimates have been prepared accordingly for both sea level and a lock canal. The canal begins at Fall River, 119,295 population; follows the Taunton River passing the town of Somerset, 2,798 population; Dighton, 2,235 population; passes within 2 miles of Berkley, 990 population, and a mile and a half of Taunton, 34,259 population; 3½ miles from Bridgewater, 7,688 population; 9 miles from Brockton, 56,876 population; 1 mile from Halifax, 550 population; through Kingston, 2,445 population, to Plymouth, 12,141 population.

On a 20-foot summit-level canal the first lock is about one-half mile south of Weir village and has a lift of 20 feet at low tide; the second lock is just east of Holmes Hill, in the town of Kingston, with a lift of 20 feet at mean low water. The summit level is

about 26 miles long and will be supplied partly by a natural drainage and partly by pumping salt water from the Jones River.

On the sea-level Plymouth route, the first tide lock is about one-half mile north of Dighton and has a lift of about 4 feet at mean low water. The second tide lock will occupy the site east of Holmes Hill in the town of Kingston and will have a lift of about 10 feet at mean low water. The natural fresh-water drainage and the difference in times of tide at the two ends will be sufficient to fill the summit level without recourse to pumping. The sea level route has in reality a summit level of 10 feet above mean low water, and the canal will be filled with fresh water for most of the year. Three branch lines of railroad are crossed, necessitating three double-track drawbridges; 25 highways are crossed, requiring 22 power-operated highway drawbridges.

The canal route from Fall River to Plymouth is 37 miles.

The estimated cost of the sea-level canal is $47,133,000, and the annual cost of maintenance, capitalized at 4 per cent, amounts to $11,835,000, making a total, including maintenance, of $58,968,000.

The estimated cost of the 20-foot summit-lock canal, with bottom width of 200 feet and depth of 25 feet, is $26,848,000. The cost of annual maintenance, capitalized at 4 per cent, is $14,785,000, making a total of $41,633,000.

DESCRIPTION OF THE TAUNTON-HINGHAM ROUTE.

The canal enters the Taunton River at Fall River, 119,295 population; passes Somerset, 2,798 population; Dighton, 2,235 population; passes within 1½ miles of Taunton, 34,259 population; 3½ miles of Bridgewater, 7,688 population; 9½ miles of Brockton, 56,876 population; about a mile and a half from Hanson, 1,854 population; through Hanover, 2,326 population; Norwell, 1,410 population; Marshfield, 1,738 population; through Scituate, 2,482 population; through Cohasset, 2,585 population, to Hingham, 4,965 population.

This canal has its summit level 35 feet above mean low water. The first lock is about one and a half miles south of Weir village and has a lift of 20 feet at mean low tide. The second is in the town of Halifax, about one-half mile northeast of the confluence of the Taunton and Wenatuxet Rivers. This lift is 15 feet. The third and fourth locks are in the town of Hingham near the Nantasket Junction station of the New York, New Haven & Hartford Railroad. They are in flight with lifts of 17½ feet each at mean low water.

The summit level extends from the second to the third lock, a length of about 26 miles, of which about 6 miles is through a lake formed by damming the North River just west of Union Bridge. About one-half of the supply of the summit level will have to be provided by pumping salt water from the North River below the dam so that under ordinary conditions the water in the canal will be brackish. The length of the canal from Fall River to Hingham is 52 miles, crossing four branch lines of railroad, necessitating three double-track drawbridges and one single-track drawbridge; also crossing 46 highways, requiring 30 power-operated drawbridges. The right of way for the canal is estimated to occupy 6,000 acres, and 3,000 acres additional would be flooded by the lake in the summit level. The engineers have estimated $900,000 for right of way, land damages, and damages to water privileges.

The estimated cost of the 35-foot summit Taunton-Hingham Canal with 200 feet bottom width and 25 feet depth, is $40,047,000, and the cost of annual maintenance, capitalized at 4 per cent, is $20,903,000, making a total of $60,950,000.

We are informed that in making the surveys across Massachusetts that a route via Brockton was found impracticable and eliminated. A Brockton canal would have required a summit level of about 120 to 130 feet; would have involved a large number of locks, causing excessive cost of construction, and would have required pumping water from a long distance for the supply of the summit level, adding considerably to the cost of construction and excessively to the cost of maintenance.

The commissioners held the following meetings:

On April 3, 1911, at the statehouse for organization; J. J. Martin elected secretary.

On April 5, 1911, at the office of Col. F. V. Abbot, Corps of Engineers, United States Army, Barristers Hall, Boston, where Col. Abbot explained the surveys and gave such information as was requested.

On April 7, 1911, an executive session.

On April 11, 1911, at the statehouse, where a public hearing was given. On the same date an executive session of the commission following the public hearing.

On April 21, 1911, an executive session.

On April 25, 1911, an executive session.

On May 1, 1911, an executive session.

INFORMATION RECEIVED BY THE COMMISSION.

A letter from Col. F. V. Abbot, of the Corps of Engineers, United States Army, dated December 27, 1910, giving information and estimates for the canal surveys and inviting information from all who might use it or were located upon the route, with reference to the necessity for such a canal or with reference to its commercial, naval, or military value, to be shown by data from reliable sources.

Memorandum from Col. Abbot of certain replies to the above letter. From nearly 1,000 of these letters sent out, those mentioned below are the ones containing responsive information:

Town of Plymouth, Mass., January 16, 1911, by Charles C. Doten, harbor engineer for the town, and approved by the selectmen.

"Evidence of commercial interest is furnished by the wreck chart published by the United States Engineer officer at Newport, R. I., in 1905, recording 1,076 wrecks from Fishers Island and Long Island Sound to the northerly end of Cape Cod, as occurring for a period of 23 years from 1880 to 1903.

"As the Government does not require record of coastwise commerce, it is impossible to ascertain with accuracy the value and amount passing over the Boston and New York route. Interested parties estimate the total freight passing Vineyard Sound to be 25,000,000 tons annually, including 9,000,000 tons of coal—75 per cent of the total pertaining to Massachusetts Bay and 25 per cent to the eastern coast and British Provinces. The annual produce of Massachusetts industries is $1,500,000,000 in value and in distribution goes principally to New York, the West, and South. Boston is the shipping port for a large contiguous territory and ships a liberal percentage of the aggregate value of the State production by sea.

"The new coal-carrying barges which are rapidly displacing the old hulks of the towing companies have a draft of from 18 to 22 feet, and the merchandise steamships vary from 17 to 24, while passenger boats require about 14 feet. The canal should have not less depth than 25 feet, and bottom width of 200 feet. The shorter sea-level route should be chosen as quicker and easier of navigation.

"The Taunton-Plymouth route is the only one which affords sea-level construction; is shorter by 27 miles than the survey to Hingham; has its terminus in a capacious, well-sheltered harbor. The harbor entrance is well defined; open water passage to Boston; 30 miles along the well-defined coast. Preference is given to the Taunton-Plymouth project.

"Distinguishing between the two routes reported upon, preference is unhesitatingly given to the Taunton-Plymouth project, but under this head more latitude may be taken and a better proposition discussed and recommended. It is a matter of common knowledge that under authority of the Government conferred upon private parties, a waterway of but 8 miles land cutting is being constructed across Cape Cod, to be completed and put into operation in about two years' time. By this concession all commerce which seeks safety from the passage around Cape Cod, will be subjected to toll or tonnage assessment. In this private and laudable enterprise, 'the line of least resistance' has been unerringly chosen, as the natural route of both freight and passenger service between Boston and New York. Large railroad, marine, and transportation interests are apparently accommodating themselves to this Cape Cod route, if not actual promoters and builders of the canal; it therefore should be a matter of close inquiry as to whether there would be any considerable amount of commerce left to traverse an across-State waterway, even with freedom from tolls to recommend it. Should it appear that the Cape Cod Canal is not only the best route, but is certain to hold nearly all commercial travel, the wise course would be not to attempt competition but to exercise sovereign rights of the Government, take over that waterway on equitable terms, and make of it a commercial 'short cut,' capacious enough to pass the largest national ships, thus establishing a quick easy line of communication between the naval stations at Boston, Newport, and New York, of great value, and at the same time freeing the largest volume of commerce on the Altantic seaboard from a tax not in accordance with the spirit of American institutions, and satisfying its need for greater safety in its passages between terminal ports.

"A concluding recommendation is that the harbor of Plymouth, which is the only deep-water inlet on Massachusetts Bay between the Cape Cod Canal and Boston, be imporved as a port of refuge and convenience by construction of a breakwater on Browns Island Shoal, to make its excellent anchorage perfectly secure in gales from any direction. This should be done in the interests of the great lines of commerce which will run near the harbor mouth, a portion of which may occasionally be driven to shelter

or seek the convenience of a way port. Plymouth Harbor bears a very important relation to intracoastal commerce by any route established in southeastern Massachusetts."

Ten manufacturers of Brockton, Mass., answer certain questions relating to the canal, of which the following answers of the George E. Keith Co., under date of October 24, 1910, and the M. A. Packard Co., under date of October 25, 1910, are characteristic:

George E. Keith Co.

1. What advantage to Brockton would a waterway be, extending from Boston to Narragansett Bay, running through or near the city, deep enough to float the largest type of freight vessel? Having more especial reference to the shoe industry both in the carriage of freight and the transportation of fuel.

Cheap transportation—fuel especially. Some foreign shipments of shoes.

2. To what point does the bulk of your output go for distribution?

Widely distributed.

3. Where does the principal part of the leather come from used by you?

Boston houses.

4. Would its delivery to Brockton by boat be of advantage to you in rates or convenience?

In a few cases.

5. Would it be of advantage either in rates or convenience to ship your output by water directly from Brockton?

In a few cases.

6. In your opinion would a line of steamers running from Brockton through an artificial waterway to the southern ports be of advantage to you in the distribution of your output?

Yes.

7. In your opinion do the steamship lines running from Boston to Philadelphia, Norfolk, Baltimore, and Savannah have an influence on railroad rates not only to the South but the West?

Very much.

8. In your opinion would it be an advantage if shipments could be made from Brockton by barges in tow through the Sound, Hudson River, the enlarged Erie Canal, the Great Lakes, to the West and Northwest?

Not in our industry.

9. Would it be an advantage if shipments could be made from Brockton by barges in tow through the Sound and on intracoastal canal south, avoiding the open ocean?

Not in our industry.

10. In your opinion would not ocean facilities such a canal would offer be of mutual advantage to Brockton and vicinity?

Yes.

M. A. Packard Co.

Your letter of October 24, together with questions regarding the advantages to Brockton of a waterway between Boston and Narragansett Bay, was received yesterday. We regret that time will not permit us as full and careful reply as we would like to make, it being necessary for you to have your reply to-night.

The advantages to Brockton of water routes for freight on raw material, as well as on our finished product, would be very great, and the time is coming when the maintenance of shoe manufacturing in this section will largely depend upon securing advantages of this sort.

Already western manufacturers are showing dealers in the Southwest the saving in freight charges between their points of distribution and New England. The transportation of fuel alone by water would prove a saving of thousands of dollars annually to our manufacturers.

A large proportion of the goods we manufacture are shipped to southern and western points, and the freight rates would be materially reduced if a large portion of the haul could be made in vessels.

A great deal of the leather used in New England, both sole and upper, could be shipped from points like New York, Philadelphia, and Baltimore, and land by vessel in Brockton and other shoe towns at much less cost than the rail routes now employed.

There is no reason why a line of steamers could not be profitably maintained for freight service, the output of our factories being about $4,000,000 per year in value, and a large part of this could be distributed by water routes to within short distances of destination. Certainly the steamship lines running between Boston, Philadelphia,

Norfolk, Baltimore, and Savannah have a very strong influence on railroad routes to the points mentioned and in through rates to the South and West.

Any scheme of transportation that permits freight to be carried over a large part of its route by water means economy in transportation and closer relations between buyer and consumer.

We ralize that there are many obstacles in the way of building the proposed canal between Boston and Narragansett Bay, via Brockton, and a few years ago the task seemed an almost useless one to attempt. Recent developments in canal construction, however, have had a tendency to convince people that the proposed route is both feasible and desirable, and the future development of New England industries will very largely depend upon the carrying out of progressive ideas of this kind.

Letter of Hon. W. W. Crapo, of New Bedford, Mass., dated February 24, 1911.

That there is needed a shorter and safer water transportation from Boston to New York and southern ports and return is apparent and needs no argument. It is a long and perilous passage over the Nantucket shoals and around Cape Cod. This is now being met in the construction of the sea-level Cape Cod Canal, where the work is being vigorously prosecuted. This route calls for the construction of 7 or 8 miles, with ample breakwaters, at a total cost of $8,000,000 or thereabouts, furnished not by the Government but by private investors. The voyage from Boston to Sandwich is no more hazardous than from Boston to Plymouth. Reaching the upper part of Buzzards Bay, there is a sheet of water landlocked and protected by a chain of islands from the gales which sweep the ocean. From the western outlet of Buzzards Bay the distance to Newport and Narragansett Bay is comparatively short and over water not troublesome. It may be wise to construct an inland waterway westward to avoid the perils near Point Judith. But that is a matter not embraced in your communication.

In my opinion, it is wiser to await the results of the Cape Cod Canal before seriously considering a canal from Hingham or Plymouth to the Taunton River. Fifty million dollars can be better expended in other internal improvements. I do not know whether it is the intention to make the proposed canal a free waterway, the United States assuming its maintenance and operation. If so, the yearly expenditure will be large. You speak of three or four railroad bridges, but this is a small number when compared with the highway bridges which will be demanded. All the bridges are drawbridges and call for much expense in opening and closing, and locks require careful treatment. Besides, the canal must be lighted its entire distance; no steamer or tug will undertake a run through the canal by compass on a dark night.

As a commercial proposition, looking at it in a business way, I see no adequate return to the commerce of the country from the proposed expenditure.

I make no mention of the political and military features of the proposed waterway, as my opinion would be valueless.

You must not infer from what I have written that I am in any manner whatever, directly or indirectly, interested in the Cape Cod enterprise or in its promoters. A closer study of the subject may, of course, modify my opinions.

Letter of A. Homer Skinner, of Fall River, Mass., dated February 18, 1911.

In regard to your circular letter dated December 27, 1910, regarding the intracoastal waterway on the Atlantic coast, and especially the link between Narragansett Bay and Boston Harbor, permit me to state my reasons why I think this link should be constructed, and why it should return large and valuable benefits to all of the southern and eastern parts of New England, and from a humanitarian standpoint will save the large toll of lives the sea annually claims from Point Judith to Boston Bay.

Now it seems to me that there are two reasons why this Narragansett Bay to Boston Bay link of the inland waterways should be built. First, that of safety, as it will save the lives of men now lost each year on the outside route between these two points. Second, that of saving the long distance of the outside route, instead of taking the short and direct line by this proposed canal between these two points.

Under the first reason permit me to say between the years 1880 and 1903 there were 1,076 marine disasters between Point Judith and Boston Bay, and 544 were off Cape Cod. Now if this canal had been in operation, in all probability most of these disasters would not have happened. During the early part of this winter a tow of three barges, in charge of the Tug Lykens, was lost off Peaked Hills Bars, and 16 men lost their lives. If this proposed cacal had been built this disaster could not have happened. In January of this year a large fleet of vessels left the Vineyard, bound around the Cape, and when off Chatham the wind died out. About 9 o'clock in the evening a blizzard came from the northwest, striking the fleet, and six of them were lost. Two

of them lost their entire crews. Up to the present date there have been 29 lives lost by marine disasters off Cape Cod this winter. The average loss of human life each year off this point is 30, and over $100,000 value in marine property. Now if this proposed canal was built, this toll of human life could be saved and also the loss of property.

Under the second reason, that of saving of time. As time is money, this could come under the head of economy. Nearly one-half the distance could be saved from Point Judith to Boston by going through this proposed canal; but the greatest time would be saved in tugs, barges, and vessels not being obliged to wait at the Vineyard for favorable weather to proceed around the Cape, and also the delay in going the other way bound to the southward and westward. If this delay could be reduced in dollars it would reach an enormous figure. With the exception of two other points, there is more commerce passing Point Judith in one year than any other place in the whole world. And as this canal would contribute to the economy of commerce on one of the world's most frequented highways of ocean travel, it would seem as if this important work should be begun with as little delay as possible.

Transportation by water costs about one-seventh of that by rail. The rate of freight from New York to Fall River by rail is 15 cents per 100 pounds, or $3 per ton. By water it is 40 cents per ton. The freight from Norfolk, Va., to Fall River by rail is 22 cents per 100 pounds, or $4.40 per ton. By water it is 60 cents per ton. The freight from Jacksonville, Fla., to Fall River by rail is 28 cents per 100 pounds. By water it is $1.25 per ton. This being the case, should we not provide every facility possible to make our waterways more convenient to our commerce?

The benefit Boston would have by this canal would be in having its rate of freight reduced 10 cents per ton by barges coming through this canal instead of going around the Cape. Boston saves 10 cents per ton on 9,000,000 tons of coal used annually, which would amount to $900,000 each year, besides saving on other commodities which would come through this canal. The points beyond Boston would also save the same sum on their coal, which would almost double this amount.

The benefit Fall River would have by this canal would be in giving to its people a connection with the outside freight world by a line separate from the New York, New Haven & Hartford Railroad Co., which on account of having no competition exacts an enormous toll of freight each year from them. The Clyde Line of steamers would probably use this canal and probably make Fall River a port of call. About 400,000 bales of cotton is used in Fall River each year. About 10,000,000 feet of southern pine lumber is used in Fall River each year. If the Clyde Line steamers make Fall River a port of call, large amounts of these materials would come by them and a great amount of freight money saved on the cotton and a much quicker delivery on the lumber. I have had steamer shipments of lumber from Jacksonville, Fla., and by the present arrangements it has come first to Boston via the Clyde Line and then shipped via the New York, New Haven & Hartford Railroad Co. to Fall River. The freight by the Clyde Line by water is $6 per 1,000 feet, or six-tenths of a cent per 1,000 feet per mile. When it gets in possession of the New York, New Haven & Hartford Railroad Co., by rail the charge is $4 per 1,000 feet, or 8 cents per 1,000 feet per mile. Now, if this canal were built I could get this stock delivered in Fall River for $6 per 1,000 feet instead of $10 per 1,000 feet. Besides what Fall River would use in cotton and lumber, this same material would come for the Providence market, and they use more than double the quantity of lumber Fall River uses. If this canal were built, it would save, in my estimation, over $2,000,000 to the business men of eastern and southern New England each year.

No doubt industries would be built on the borders of this canal, for with the reduced cost of the raw material and the reduced cost of the finished produce which this canal would give on account of its water transportation it certainly would attract capital.

Passenger and light-package freight lines would be established between Providence, Fall River, and Boston, and while we now have to pay from $1.50 to $3 per ton freight from Fall River to Boston, these steamers running through this proposed canal would be able to carry it for at least $1 per ton and make good money in the business.

As to the type and dimensions of the canal, it would seem to me if a sea-level canal could be constructed from Narragansett Bay to Boston Bay with a depth of 25 feet and a bottom width of 200 feet, it would serve the purpose to the best advantage. If it is not possible to construct a sea-level canal without too great expenditure of money, then a lock canal would have to be built with only one lock if possible.

I am very much interested in this canal, as I can see its very great advantage to southern and eastern New England, and trust a favorable report will be made by the Board of United States Engineers, so that the work may proceed with as little delay as possible.

Letter of New York, New Haven & Hartford Railroad Co., dated January 28, 1911.

Referring to your letter of December 27, in regard to a proposed canal between Boston Harbor and Narragansett Bay:

The project does not commend itself to our people.

It is stated that such a waterway would shorten the distance between New York and Boston 20 miles over the route through the Cape Cod Canal, now under construction. Our belief is that such a waterway as is proposed would not have much, if any, influence upon the movement of merchandise traffic to and from New York and the territory traversed by the canal, because the service would be slower than now afforded by prevailing routes. For the most part merchandise is now loaded at interior Massachusetts manufacturing towns in the afternoon and is landed in New York the following morning, being substantially express service at freight rates. Such service by craft suitable for navigating the canal would be impossible, but would consume substantially 24 hours longer time in transit, taking into account early morning delivery in New York.

To effect equally early delivery by the canal route would entail earlier departure from the manufacturing point, resulting in the longer time in transit by "taking off" at the starting point. Furthermore, only such places could be served as were actually upon the shores of the canal, because to reach places located a greater distance than could be covered by dray teams would entail the use of the railroad, the rates over which plus the handling charges and canal boat charges would be greater than the current rates via the present routes.

Without the aid of a map showing the exact location of the proposed canal, it is presumed in a general way that it would not serve more than three or four towns between Hingham and Taunton and these would not produce sufficient traffic to support a steamboat line to and from New York. Boston-New York traffic would most likely seek the Cape Cod Canal route in ocean steamers of the type now plying between New York and Boston, in which freight is carried at the present time at rates below which boats plying the inland canal route could not go and derive a profit from the service.

It should be borne in mind that a large part of the traffic now moving between New York and Boston proper travels by rail in fast trains which make the run in less than 10 hours and at rates higher than charged by the present all-water route. It is a certainty that this traffic would be unaffected by the proposed canal route. The only traffic that might move through the canal would consist of coal, provided it were constructed suitably for the passage of tugs towing barges of 3,000 to 5,000 tons capacity in strings of from three to six barges. Water-borne coal reaching Boston starts from South Atlantic coast ports in the main; the rates are generally low, ranging from 40 to 85 cents per ton, according to season and volume of tonnage.

It would be difficult to pass these barges through locks and the operation would consume much time. It is not a fair assumption that this traffic could in any manner be transferred from the larger carriers to the smaller craft that would naturally ply the canal; consequently it is inconceivable how the canal boats could reach any of this heavy tonnage—not heavy in volume, but classed as "heavy" in transportation parlance. Coal originating at New England tide-water points for places located on the canal would be affected, but the volume is not large.

Altogether it does not seem to us that the proposition to construct a canal such as described has serious merit. There are so many avenues of transportation at present between New York and Boston and interior Massachusetts points that the rates of transportation are very low. They could not be materially reduced by carriers using the proposed canal route and leave a margin for profit unless such lines were supported by Government subsidy.

Further information received by the commission.

Project of the Atlantic Deeper Waterways Association. (A summary of papers on the subject with statistics of coastwise commerce.)

The Atlantic Deeper Waterways Conference (report of proceedings), held at Philadelphia, November 18, 19, and 20, 1907.

The Atlantic Deeper Waterways Convention, held at Baltimore, November 17, 18, and 19, 1908.

The Atlantic Deeper Waterways Convention, held at Norfolk, November 17, 18, 19, and 20, 1909.

Atlantic Deeper Waterways Convention, held at Providence, August 31, September 1, 2, and 3, 1910.

Tabulated Statement Relating to International Waterways Improved by the United States Government, January 1, 1910.

Canal Connecting the Rhine and the Elbe Rivers, Germany (copy of an act for the construction of a navigable canal from the Rhine to the Elbe, and report on project, description, and tables of cost, etc., of canals and canalized rivers in Germany), Document No. 8, July 21, 1909.

The Port of Hamberg and the Lower Elbe (letter from the Chief of Engineers, United States Army, inclosing report of Maj. F. A. Mahan, Corps of Engineers, United States Army, retired), Document No. 5, 1909.

Rivers of China, Korea, and the Russian Far East (letter from Hon. Willard D. Straight, consul general of the United States at Mukden, China, inclosing memorandum on the navigation of the rivers of China, Korea, and the Russian far east), Document No. 3, 1909.

Regarding Practicability of Storage Reservoirs to Prevent Floods and to Benefit Navigation on the Ohio and Other Rivers of the United States, Document No. 14. January, 1910.

Questions for Consular Officers in Europe, to Follow Letter from the State Department, Document No. 2, 1909.

The Waterways of the United States; Actual Expenditures and Results to Navigation and Commerce, Document No. 15, March, 1910.

An Act to Provide for the Repair, Maintenance, and Preservation of Public Works on Rivers and Harbors, and for Other Purposes, Public, No. 317.

The Royal Commission on Canals and Waterways (summary of the report of the Royal Commission on Canals and Waterways of Great Britain, by Mr. Woodbury Pulsifer, secretary Committee on Commerce, United States Senate), Document No. 9, July 24, 1909.

Questions Showing the Scope of the Work of the National Waterways Commission, Including Inquiries Transmitted to Consular and Engineer Officers of the United States (questions to be considered by the subcommittees of the National Waterways Commission), Document No. 6, 1909.

Canals and Navigable Rivers in the District of Berlin, Germany (letter from Hon. Frank H. Mason, consul general, Berlin, Germany, to the Assistant Secretary of State, Department of State, Washington, D. C., transmitting report on the canals and navigable rivers in the district of Berlin), Document No. 1, 1909.

Preliminary Report of the Inland Waterways Commission, Document No. 325, 1908.

European Waterways (reports of consular officers of the United States, located in Germany, Austria-Hungary, France, Belgium, and the Netherlands, on river and harbor improvements in their respective districts), Document No. 7, July 20, 1909.

A Traffic History of the Mississippi River System, Document No. 11, December, 1909.

Railway Freight Rates Inland Waterways and Canals in France, Document No. 16, 1910.

Inland Waterways and Canals and Railway Rates of the United Kingdom, Document No. 17, 1910.

Railway Freight Rates Inland Waterways and Canals in Holland, Document No. 18, 1910.

Railway Freight Rates, Inland Waterways and Canals of Germany, Document No. 19, 1911.

Letter of Col. Abbot, April 17, 1911, giving a description of the proposed canal.

Extract from a letter from George S. Smith, president of the Boston Chamber of Commerce, dated April 13, 1911.

I was sorry not to have an opportunity the other day to explain to you and the other members of the commission why the chamber is unable to give its indorsement to the construction of the proposed canal across Massachusetts, from Fall River through Taunton.

The chamber is at all times anxious and zealous for the advancement and upbuilding of New England, and if it felt that the facts justified its doing so nothing would give the officers and members of the chamber more pleasure than to indorse and actively support this project; but the chamber's committee have been entirely unable to find any grounds upon which the construction of the canal could be recommended and urged.

Probably it will be impossible to expend $50,000,000 or $60,000,000 for any purpose which would not result in some benefit; but we feet that the real question is whether these advantages and benefits are sufficient to warrant the expenditure of this large sum, also whether, if the United States Government can afford to spend this amount of money for New England, it will be of greater benefit to Massachusetts and New England if spent for this particular purpose than for other purposes.

City of Fall River, Mass.,
Executive Department,
April 24, 1911.

Massachusetts Inland Waterways Commission.

Dear Sirs: Referring to the matter of inland waterways, would say that I believe it to be the almost unanimous opinion of the citizens of Fall River that the proposed Government ship canal between Narragansett Bay and Boston Harbor will be of the greatest benefit to our industries, and I heartily record my indorsement to the same.

Yours, respectfully,

Thomas F. Higgins,
Mayor of the City of Fall River, Mass.

City of Fall River, Mass.,
City Clerk Department,
In Board of Aldermen,
February 20, 1911.

Resolved, That this board, realizing the great benefit this city will receive should the proposed Fall River to Boston canal become an actual fact, record itself as favoring the proposed legislation relative to inland waterways.

In Board of Aldermen, *February 20, 1911.*

Adopted.

John Crowther, *City Clerk.*

A true copy.
Attest:
[seal.] John Crowther, *City Clerk.*
April 24, 1911.

The president of the Massachusetts State Board of Trade communicated the following resolution adopted at a meeting of the executive council held in Boston March 16, 1911:

"That the committee on statistics and information be requested to communicate with the affiliated organizations, and endeavor to awaken a lively interest in the question of United States waterway improvements and procure for Col. Abbot the information desired by him to the end that Massachusetts may not be reported as indifferent to this great project."

The following information was obtained through personal inquiry by Mr. Bernard J. Rothwell, of the commission:

L. K. Thurlow (of Crowell & Thurlow).
Capt. Peter Crowell (of Crowell & Thurlow).
William H. Randall (of John S. Emery & Co.).
Capt. Coombs (with John S. Emery & Co.).
Capt. John G. Crowley.

These vessel owners and operators were all asked for their views as to the extent to which the proposed Fall River-Hingham canal would be used by sailing vessels, steamers, or tows, and without exception their opinions ranged from "very little use" to "no use at all."

They are of the opinion that in bad weather it would be risky for steamers; that the slow speed and use of locks would permit no saving in time; that sailing vessels would have to be towed; that the towage in the case of coal vessels would be an important percentage of the entire freight; that barges could not be towed in procession, but would probably have to be towed singly, certainly not more than two at a time; that in fair weather steamers would as soon go outside and sailing vessels would preferably, rather than pay any towage; that in bad weather sailing vessels going south would not leave Boston; that coming north there would be about as much risk in approaching the entrance to the canal as in keeping well out to sea around the cape; that vessels from southern ports such as Baltimore, Newport News, and Philadelphia would not come through the Vineyard but would keep outside of Nantucket, so that the canal would not be in their regular course; that the canal would freeze up and that the entrance would be so piled with floating ice in winter that it could not be entered.

It was stated that 25 feet of water would not permit of a vessel of over 22½ to 23 feet passing through.

Mr. Ransom B. Fuller, president of the Boston Insurance Co., stated that insurance rates for outside route are already extremely low and that the difference via either the Cape Cod Canal or the proposed Fall River-Hingham Canal might possibly be 20 per cent less than by the outside route around Cape Cod.

Mr. Charles Skentelbery, manager New England Coal & Coke Co. fleet, stated that in the event of construction of the proposed canal not one of the vessels of their fleet would ever use it; that they could not afford to do so because of the risk of navigation and the slow speed which would be necessary, delays at locks, etc., that they would invariably choose the outside route. He stated the tendency in coal carrying to be toward steamers rather than sailing craft; that he believed the only use that would be made of the canal would be by barges or special canal boats; that he did not believe such use either to or from the towns en route or as a through artery of transportation would justify any such expenditure as this project calls for.

S. R. Crowell, ship broker and vessel owner, Cunard Building, vessel broker and operator of coastwise coal-carrying schooners, stated that in his judgment no seagoing vessel operated by her own steam or sail would ever use such a canal, as the expense of towing through the canal would absorb so large a percentage of the through rate as to make the outside route decidedly preferable. He believes the delays incident to fog or contrary winds off the cape no greater than would be likely to prevail through similar cause or ice obstruction at the entrance to the canal, even if the canal itself could be kept open, which he doubted.

Capt. John M. Ward, of Marblehead, formerly treasurer of the Boston Theater, and now operating three or four coastwise coal-carrying schooners, expressed the same belief even more strongly.

Rogers & Webb, shipowners and vessel brokers, Cunard Building, operating coal-carrying three and four masted schooners, did not believe the canal would be of any practical use to seagoing self-propelled vessels, either steam or sail, and thought there could be no possible advantage resulting from the use of the canal which would justify the cost of construction or of maintenance.

J. Frank Wellington, of the Wellington-Wilde Coal Co., stated that there was possibility that barges might be towed through the canal to some extent if they could be towed tandem or abreast; that he did not believe the canal would be used by sailing craft except in a long continuous spell of bad weather because of the cost of towage, and that it would not in any event be used by steamers; that he believed the Cape Cod Ship Canal now under construction would provide any necessary means of avoiding Cape Cod in bad weather; he furthermore believed from his experience at his wharves on the Charles River and in regard to keeping the channel open there since the construction of the dam, that it would be impossible to keep such a canal open during the winter months; that a tug is constantly employed 24 hours in the day moving up and down the Charles River during extreme winter weather; even if the ice were broken up in the canal it would have no place to float off because of there being no material current and therefore that it would pile up in the canal so as to obstruct navigation.

R. R. Freeman, ship broker, 95 Commercial Street, was chairman of house committee on harbor and public lands in 1904 and 1905. He stated that in his judgment no type of vessels now carrying coal or lumber between southern ports and Boston would use the proposed canal under any circumstances; steamers would not bother with it as they would gain no time; sailing vessels could not pay the towing charges; barges could not safely be towed more than one at a time; sailing vessels are only caught twice, at the outside three times a year, so as to be delayed badly in going around the cape. In his opinion there would be absolutely no warrant for such an expenditure for construction or upkeep as this canal would involve.

Capt. John Ross, pilot commissioner, is strongly in favor of the proposed canal and believes it would be used by practically all craft. He insists, however, that the canal should not be less than 30 feet deep.

George Wooley, connected with the Commercial Tow Boat Co., believed vessels of all classes would go through the canal, and believed the use of it and the advantage to the State would justify the investment. He believed that vessels could be towed in tandem three behind a tug, which is contrary to the opinion of every other vessel man interviewed.

Mr. A. Homer Skinner, of the commission, submitted the following questions to parties employed in navigation of vessels and obtained the following answers:

In relation to the Government ship canal from Boston Bay at Hingham to Narragansett Bay at Fall River with a depth of 25 feet and a bottom width of 200 feet and a top width of about 300 feet, what are your answers as an experienced mariner to the following questions:

1. Question. Would the coastwise steamers of less than 23-foot draft running to and from Boston through Vineyard Sound use the canal?

J. H. Diehl, master, steamship *City of Macon*, Ocean Steamship Co.: All of them.

T. I. Winsor, Boston Towboat Co.: I think so.

V. Z. Ryan, pilot and second officer, steamship *Gloucester*, Merchant & Miners Transportation Co.: All of them.

J. A. Crocker, pilot and second officer, steamship *Indian*, Merchant & Miners Transportation Co.: All of them.

Bruno E. Webber, pilot, steamship *Macon*, Ocean Steamship Co.: Probably all coastwise steamers.

A. H. Brooks, pilot and second officer, steamship *Juniata*, Merchant & Miners Transportation Co.: They would, I am sure.

2. Question. What proportion of towboat and barge traffic that runs through Vineyard Sound would use the canal?

J. H. Diehl, master, steamship *City of Macon*, Ocean Steamship Co.: Probably all of them would use it.

T. I. Winsor, Boston Towboat Co.: All in bad weather; many at all times.

V. Z. Ryan, pilot and second officer, steamship *Gloucester*, Merchant & Miners Transportation Co.: Probably all of them.

J. P. McKimmon, master tug *Charles Mann*, and Felix Guilmet, master tug *Chas. T. Gallagher*, of the Commercial Towboat Co.: All the Commercial Towboat Co. represents.

James Woolley, treasurer the Commercial Towboat Co.: All the Commercial Towboat Co. represents.

3. Question. Would sailing vessels under 23-foot draft use the canal; and if so, under what circumstances?

J. H. Diehl, master, steamship *City of Macon*, Ocean Steamship Co.: Unfavorable and stormy weather.

T. I. Winsor, Boston Towboat Co.: Can not say.

A public hearing by the commission was given on Tuesday, April 11, 1911, at 10.30 a. m. at the State House. Notice of the hearing was given by public advertisement and press notices and by 1,000 circulars letters sent to steamship companies, towboat companies, vessel owners, brokers, cities, and towns along the routes of the proposed canal, executives of the New England States, railroad companies, trolley companies, etc.

The following is a condensed summary of the evidence presented to the commission:

Statement of James E. Lewis, of Taunton.

Taunton is the largest city on the proposed line of Atlantic deeper waterways and is probably more interested than any other point on the coast on all the proposed lines of canals.

Under Col. Abbot's proposed plan the first lock would be within a mile and a half of the center of Taunton and within half a mile of the business section where the ranges and stoves are made.

Statement of Capt. John W. Hammond, of Taunton.

I have been in the transportation business a little over 25 years. I would like to say that the water port of Taunton, known as Weir, is where most of the industries of iron, all the coal wharves, and most of the lumber wharves are situated, and this river runs right through the city, within the distance from city hall which Mr. Lewis has already stated.

There are now taken to Taunton about 100,000 tons of coal, of which 75,000 tons are carried by water. About 30,000 tons of iron and 10,000 tons of lumber, nearly all of which comes by rail. This lumber which comes by rail pays an excess freight from Fall River into New Bedford, as against Taunton. The lumber that comes to Fall River and New Bedford through Taunton is delivered cheaper to those other cities than to Taunton because the other cities have competition by water, and they meet the competitive water rate. The lumber comes from both South and East.

In addition to our little business on the Taunton River we move some 45,000 to 60,000 tons of coal to Boston and ports in its vicinity around the cape which I feel confident we should move through the canal, utilizing the canal for all our tonnage. Under the present conditions about 40 per cent of the time is lost on account of the winter weather in going around the cape, and that could be saved if we had this canal.

I myself am not in favor of 17 feet or 25 feet depth of canal. I would suggest a compromise of 22 feet; 17 feet is not adequate, and it does not seem necessary for a 25-foot canal. The reason is that most vessels are being built to 20-foot draft. I favor a compromise canal with a little less draft, a little less than the initial cost, and a little less cost of maintenance to meet the conditions equally well.

There is a lot of package freight that would come by packages and a good deal of grain would come up by water. While the canal would not, I understand, go near enough to Brockton to be within carting distance, it is only a matter of a small side canal to go up there. I do not advocate that the canal go to Plymouth. They have the same conditions there that you have in Cape Cod Bay, but not quite so bad, but, as I said, the chief trouble now in moving vessels is the weather conditions, and those would be largely eliminated if the canal touched Boston.

I think the canal would nearly parallel the railroads, and I can see why the railroads would rather object to the canal going through. Nevertheless, it would in one item alone, freight from Fall River to Taunton, probably decrease the cost of moving said freight from 30 to 40 cents a ton. Freight from Fall River to Taunton, water-borne freight, could be taken up for 10 cents from Fall River to Taunton.

There is all kind of freight between Fall River and Taunton, and we send all-rail coal that we discharge in Fall River; we send it through to Brockton and all up through, until it can meet the freight rate from Boston south. We ship from Fall River alone, I think, some 30,000 or 40,000 tons by rail.

Regarding the conditions in winter between Taunton and Fall River and have had only one case of trouble from ice in three years, and that was winter before last, and then it was only because the new bridge could not be opened and we could not run vessels up there and the river closed in. After we got the river opened again we kept it open through the rest of the winter.

We move about 60,000 tons of coal a month with our own vessels, and in addition to that the Lehigh Coal Co. has about 15,000 more a month. It is from Norfolk, Newport News, Philadelphia, and New York to Massachusetts only.

Vessels bound around Cape Cod from Newport News, Norfolk, and New York, bound to Salem and other distributing points, lose 40 per cent of time in the winter months—that is to say, that nearly one-half of the time is wasted for sea-going barges in tow. Not half of the time taken to go around Cape Cod, but half of the time in the month. For instance, if the month comprises 100 per cent of the time, she loses 40 per cent of the time waiting.

Judging from experience and from our own transportation and from the transportation that is now being built 17 feet is too shallow for a barge canal. Barges for towing purposes—I would not consider schooners, as I think they would not use the canal. A 22-foot canal suitable for tugs and barges would be suitable for schooners and any steamships on our coasts can go through it.

We have no coastwise ships except some big coal-trading ships that are run now, and they draw sometimes 26 or 27 feet, and there is less than 1 per cent of the tonnage that would be accommodated in a 25-foot canal that would not be accommodated in 22 feet. Some of the larger ships, the Merchants & Miners, and all of these big colliers that have been built, are drawing 26 or 27 feet of water and could not go through. They must have 1 or 2 feet below the keel, so that they won't strike the bottom.

My idea of the bottom width of the canal was 200 feet, and 22 feet deep. Would use it towing tandem, in tows, through the canal. That would leave a proper turnout for vessels going the other way, so that vessels could use that canal both ways at the same time. One hundred and twenty-five feet would be hardly enough. I think you could tow three, the regular ship tow.

I think you could save 25 per cent of the time, in all weathers, through such a canal from Narragansett Bay to Boston, or a saving of 5 cents a ton. We figure that one of our tugs is worth $150 to $175 a day. In ordinary weather we would save nearly a day, and in the winter time we should say five or six days or 10 days; possibly a month. The ordinary tug with three barges would cost $250 to lay up a day. The consumer suffers this loss; that is, it is charged up to the consumer in the final analysis.

If we could go through the canal to Fall River we could go through the Sound and then south under all weathers. Forty days' time out of 100 are lost during the winter because it is necessary to round Cape Cod, and I think this loss of time could be saved by this canal.

We would expect ice to form in the canal, but it would be broken up by towboats. Towboats are great ice breakers. The ice would be broken up like porridge and crowded right to the shores. It would not interfere with navigation. The speed in the canal will be 4 or 5 miles.

Seventy-six vessels are running to Taunton all the time. I have had it for two weeks that we have taken one up and one down each day, and then we have intervals of no transportation, because there is nothing there to take up.

If we could land coal at Taunton, the rate to Brockton or the rate to Middleboro or Bridgewater, or any of those places in there, would be lower. A canal up to Taunton would lower the cost or price of soft coal to Taunton and would have a tendency to lower the price into Boston.

The saving in construction of light barges, if we were assured we could use this canal, would be about 50 per cent. It costs about $20.50 a ton to build a seagoing vessel, and it costs about $9 or $10 a ton to build this class of box barge.

Sailing vessels, moving at sea by their own sail power, would go through the canal if they saw fit to make that port. If they made Newport for a harbor they would tow through to Boston. They are not building any smaller sailing vessels.

I do not think there would be any small sailing vessels left at the time this canal could be completed. The sailing vessels that will be left will be large and draw 24 feet and upward. All the Merchants & Miners coastwise steamers could go through. The large bulk of coal transportation is by barges. Perhaps 20 per cent of it is now taken in sailing vessels. Coal is largely carried by towing.

I can not conceive of any weather that would hardly stop you from entering this canal unless it was a fog, so that you could not see the approaches. Wind and storm would not stop you from entering that canal. If it comes out at Hingham and goes in from Fall River and you are in those ports it would not delay you more than 1 per cent.

It seems feasible to me to dig a small canal up to Brockton from the main canal. It could be a lock canal for that matter, and then you could put an electrical connection in there and run freight right up there overland.

Mr. Lewis. I would like to say that the railroad rates on coal from Fall River to Taunton is 60 cents a ton. I would like to ask Mr. Hammond what it is by water?

Mr. Hammond. We charge 20 cents.

Statement of Mr. Clinton B. Sanders, of Taunton.

We receive between 300 and 400 cars of lumber a year. If we had a canal at least half would come by water. The rate from New Bedford and Fall River is 15 cents by rail, and to Taunton it is 19 cents, because we are an inland town. If we had a canal we would be a seaport town, and we would save from $1 to $1.60 on all our lumber per thousand feet. A canal to Taunton, deepening the Taunton River, would put us on the seacoast, the same as a through canal. It would save us a railroad freight of $1 to $1.50.

We would get our lumber from Maine and Nova Scotia by water if we could have a canal to come that way, from the Boston side, and that would save us $2.40. Twenty cents more for handling, and altogether $2.65.

The total amount of lumber consumed in Taunton in one year is 10,000,000 feet, so the maximum saving would be over $20,000.

There is a large consumption of iron in Taunton. That would use the canal to advantage. The population of Taunton is about 35,000 now. We were about 32,000 10 years ago.

We truck our lumber to Middleboro, Attleboro, and Brockton, and most of it is water-borne lumber. Brockton would save on its lumber by having it come to Taunton.

Statement of Mr. Charles A. Ufford, of Boston.

What we want is to get this line through from New York. We are in the manufacturing business and ship by the Fall River line. We do not ship a great deal, but we have a ton of paper and things like that.

Statement of Mr. A. E. Robbins, treasurer Corr Manufacturing Co., of Taunton.

In getting material we have great difficulty with the railroads in getting service. The canal would serve us perfectly. It would develop a section of the country that lies dormant now and has possibilities. To my mind it is a very satisfactory location for any large manufacturing enterprise. It would save us $4,000 or $5,000 a year. The assessed overcharge and very complicated arrangements and limitations in loading freights add materially to our freight charges. There would be a saving on cotton in and cloth out, and coal and all other supplies which we use in large volume. In addition to the barge transportation, as the scheme works out now, we have to pay the haulage charge. In the case of a canal we could unload our own supplies at our place.

Statement of D. Gardner O'Keefe, Esq., City Solicitor of Taunton.

In my opinion the canal which is laid out on this map which appears before us here is the only feasible project of this kind, the canal from Hingham to Taunton, 200 feet wide at the bottom and 25 feet deep at the maximum expense. If that canal were to run into Plymouth Harbor, so called, it would be impracticable.

It is a notable enterprise which should be encouraged. It will not only benefit the locality through which it runs, but it will be a godsend to Taunton. There are industries down there now practically laying dormant for the reason that they are unable to compete with industries in the South. The iron and lumber and coal have to be shipped up there at increased rates.

If that canal would save human life it would be well worth $100,000,000.

It is the inland waterways in my opinion that need building up. The hope of the future bulk transportation is at lower cost. I do not think that canal would be so circuitous as to be dangerous for towing. The canal ought to show a saving of at least $3,000,000 a year to justify its construction.

Statement of Mr. Frank M. Chase, chairman of the Bristol County Commissioners.

I am chairman of the county commissioners of Bristol County, and they are all in favor of this proposition before your commission. It would benefit the county a great deal. I feel now as though something was about to be consummated.

Statement of Mr. Edmond Cote, of Fall River.

I am here to represent the Merchants Association of Fall River, which passed a vote urging the canal as proposed on the map at my right. They believe it will promote the industries of Fall River. It will facilitate freight transportation between Fall River and the South, and between the South and Boston. This is the principal reason why this canal should be built. I do not believe that this canal could be built for passenger purposes and be a paying institution, because it is essential for freight accommodation. If this canal is built by the Government it will also promote a great many manufactories all along the line. It would help to increase the manufacturers' business all over Massachusetts.

I believe that the investment of sixty or more million dollars is warranted by the increased business which Massachusetts would get. I believe that the increase in business along the line will guarantee a saving of more than the interest on the investment.

The population of Fall River is 125,000. It has increased 15,000 in the last 10 years. The trade between Boston and Fall River would be increased if the canal were built. I think manufacturers would try to build around this canal.

Statement of Mr. B. R. Acornley, of Fall River.

I represent the Fall River Trade Industrial Association, and desire to have this canal go through, not only from the business standpoint, but from the standpoint of the lives that have been sacrificed in the past and the saving of life. We have loss of life around the cape which has been exceedingly great, and I think the canal would prevent that. I think the amount of money the Government might invest in this canal would be a good investment.

Statement of Alderman Charles A. Macdonald, of Fall River.

I am in favor of the canal. I consider that the arguments for life-saving are very strong.

Statement of Mr. Robert A. Dean, of Fall River.

This canal going through there is going to give us a lower freight rate, which will insure for us fair treatment by the railroad. A 5 per cent return on $60,000,000 strikes me as not at all unreasonable. I think I can supply some figures to show where they will get a considerable part of it right here in Fall River.

Statement of Mr. G. W. Cook, of Haverhill.

I would advocate having a canal deep enough to take the deepest warships, 30 to 35 feet deep.

Statement of Senator Charles S. Chase, of Dighton.

I think it is a project that would be highly beneficial to the shipping, and not only to the Commonwealth but to the whole country. The iron industry has been driven out of business in the last 25 years owing to competition in the other parts of the country. If the canal were built, it would develop the whole country about Dighton.

Statement of Mr. Edward L. Burwell, of Winchester.

Ships at Providence, if they were going to Liverpool, I do not think would use this canal, but if we had a terminal here at Hingham I think vessels from England and France and other parts of the world will bring freight here and deposit it at this terminal, and that there would then be facilities for transshipping it to other ports. The only feasible canal is a canal that enters Boston Harbor.

CONCLUSIONS.

How to cooperate.

The act of Congress authorizing the surveys for the Boston-Narragansett Bay portion of the intracoastal waterways system specified a depth of 25 feet, or such lesser depth as may be found sufficient for commercial, naval, or military purposes. The Army engineers have, therefore, in preparing their surveys made also estimates for canals of 18 feet depth, and their estimates are contained in the following table:

Description.	Depth of water.	
	18 feet.	25 feet.
Lock canal (35-foot summit, bottom width 200 feet):		
Cost of construction, Taunton River to Hingham Harbor	$29,590,000	$40,047,000
Cost of annual maintenance capitalized at 4 per cent	20,178,000	20,903,000
Total cost	49,768,000	60,950,000
Lock canal (35-foot summit, bottom width 125 feet):		
Cost of construction, Taunton River to Hingham Harbor	24,955,000	32,470,000
Cost of annual maintenance capitalized at 4 per cent	20,178,000	20,903,000
Total cost	45,133,000	53,373,000
Lock canal (20-foot summit, bottom width 200 feet):		
Cost of construction, Taunton River to Plymouth Harbor	20,570,000	26,848,000
Cost of annual maintenance capitalized at 4 per cent	14,035,000	14,785,000
Total cost	34,605,000	41,633,000
Lock canal (20-foot summit, bottom width 125 feet):		
Cost of construction, Taunton River to Plymouth Harbor	17,453,000	21,678,000
Cost of annual maintenance capitalized at 4 per cent	14,035,000	14,785,000
Total cost	31,488,000	36,463,000
Sea-level canal (bottom width 200 feet):		
Cost of construction, Taunton River to Plymouth Harbor	35,696,000	47,133,000
Cost of annual maintenance capitalized at 4 per cent	11,035,000	11,835,000
Total cost	46,731,000	58,968,000
Sea-level canal (bottom width 125 feet):		
Cost of construction, Taunton River to Plymouth Harbor	28,429,000	37,420,000
Cost of annual maintenance capitalized at 4 per cent	11,035,000	11,835,000
Total cost	39,464,000	49,255,000

NOTE.—All river and harbor sections to have a bottom width of 300 feet.

The cost of an 18-foot canal over the Taunton-Hingham route of 200 feet bottom width is $29,590,000 as compared with $40,047,000 for the 25-foot depth. The commission finds that 18 feet depth would be insufficient for a modern coal-barge traffic and would not constitute a ship canal, to which its consideration was limited by the resolve, and therefore have limited their consideration and conclusions to canals of 25 feet depth and 200 feet bottom width.

The resolve invites the commission to consider and report in what manner the Commonwealth of Massachusetts may best cooperate with the Federal Government in the construction of a free ship canal to be free and open to the commerce of the world, without tolls or charges for the passage of freight.

The commission understands that the project anticipates the construction of the canal by the United States Government and that the United States will operate and maintain the canal at its own expense, and that the question is, How may the State of Massachusetts best cooperate with the Federal Government to bring about this state of affairs?

The commission is of the opinion that cooperation with the Federal Government can only take effect by sharing in some manner in the cost of the construction and in the supplying by the State of such facilities in the way of terminals, both at the ends of the canal and at intermediate points, as will make the canal useful and convenient for the shipment and receipt of vessels and freight. The State of New Jersey has, by the act of the legislature and approved by the governor, obligated itself to the expenditure of $500,000 to provide and convey to the United States a right of way for the canal project as a part of the intracoastal system from the Delaware River to the Raritan River. The engineers estimate the cost of the 9,000 acres of land required for the Taunton-Hingham route and the cost of land damages and damages to water privileges at $900,000. It appears to the commission just and fair, in view of the magnitude of the project, that if construction is determined the State should contribute the right of way. The commission believes that to realize the expectations of the advocates of the intracoastal system a large portion of the traffic of the canal must be in barges towed or self-propelled, and to make this traffic convenient and economical for local and through service it will be necessary to provide special piers, storage, and handling appliances, both at Fall River and at the Boston Harbor terminals of the canal, and that it will be necessary to provide cut-outs, piers, storage and handling appliances at such intermediate points in the canal as Dighton, Taunton, the nearest points to Brockton and Bridgewater, and possibly at some other points. These facilities should be contributed by the State, and they will cost no less than $1,000,000.

The above is the commission's conclusion as to the manner in which the Commonwealth of Massachusetts may best cooperate with the Federal Government.

The resolve also invites the commission to consider how best the Commonwealth may cooperate with other States along the Atlantic seaboard, or especially with Rhode Island, in the development of these inland waterways. The commission finds that cooperation with the other States would comprise:

First. Taking part in such congresses and waterway conventions as may be held to consider the subject of waterways, in appearance before national commissions and committees of Congress having the subject under consideration, in correspondence with the authorities of the other States with reference to the above matters. These duties can be performed by the Massachusetts State Harbor and Land Commission.

Second. Instructions by the legislature to its Senators and Representatives in Congress to cooperate with those from other States with reference to the intracoastal waterways.

THE VALUE OF A SHIP CANAL TO THE STATE.

The resolve invites the commission to consider the value of such a canal to the State and its inhabitants in the development of industries, the reduction in the cost of handling raw material and manufactured products or otherwise, and the benefit to transportation generally along the Atlantic coast.

The conditions which justify the construction of ship canals are very farily set forth in the preliminary report of the United States National Waterways Commission, of which Senator Theodore E. Burton is chairman, and Senator J. H. Gallinger, vice chairman, Senate Document No. 30 (61st Cong., 2d sess.,) from which we quote as follows:

"The commission has had under consideration the question of the construction of artificial canals adapted to the passage of seagoing ships. An examination of this subject has led to the conclusion that this class of waterways is only profitable under certain well-defined conditions, of which the following are the best illustrations:

"First. Canals connecting navigable waters located near to each other, between which large traffic would naturally exist, except for rapids, a barrier readily overcome, or the existence of a comparatively narrow strip of land. The Sault Ste. Marie Canal, connecting Lakes Superior and Huron, is perhaps the best example. This canal, 1.6 miles in length and constructed at a cost of about $9, 300, 000, renders the almost unlimited resources tributary to Lake Superior available to the other lakes and provides for a return commerce considerably less in volume. Other illustrations are the Welland Canal, 26¾ miles in length, with 26 locks, connecting Lakes Erie and Ontario, and the Lachine Canal, constructed for the purpose of obviating rapids in the St. Lawrence River.

"Second. Comparatively short canals, which save a very great sailing distance, such as the Suez Canal, 87 miles in length, which furnishes a substitute for the voyage around Cape of Good Hope and saves in the sailing distance from Northern and Western Europe to Calcutta 3,700 miles, and to Hongkong, by the Straits of Sunda, 3,300 miles. Also the proposed Panama Canal, 49 miles in length, which obviates a voyage around Cape Horn, and saves in the sailing distance from New York to San Francisco more than 8,000 miles. Another illustration is the Kaiser-Wilhelm Canal, 53 miles in length,

which, though constructed primarily for military purposes, is largely used for commerce, and saves in distance for vessels bound from the English Channel to the Baltic about 200 miles.

"Third. Canals from the sea to large cities situated not far from the coast, where communities have grown to large size and become great producers or consumers of freight without connection with the ocean. In these cases, with increased commercial and manufacturing importance, it has become a practical necessity to establish communication with the sea. The best illustration of this class is the Manchester Canal, 35½ miles in length, with a least depth of 28 feet. The canals in Belgium, from the North Sea to Bruges, to Ghent, and to Brussels, are also good examples of this class.

"The reasons for the disadvantages of canals as compared with natural waterways are obvious. In a narrow channel a boat moves with much less speed and with far greater difficulty and danger than in a natural waterway where there is sufficient sea room. Since the speed of the slowest boat determines the speed of all, it is not probable that any time could be gained by using a canal unless the distance saved were very considerable. Also, there is the constant danger that in the handling of a large vessel, which is not adapted for navigation in a narrow channel, it will strike against the bank or works of construction and not only incur delay but also serious damage. This possibility increases the cost of insurance. It is conceivable, however, that with improved methods of handling vessels this advantage might be somewhat lessened. It should be added in this connection that persons familiar with navigation have stated, in answer to inquiries on this subject, that even if canals of deep draft should be constructed on certain proposed routes in this country and were entirely free from tolls or similar charges, large vessels would make no use of them, preferring to go where there is greater sea room. Ocean-going boats are so expensive in first cost and daily operation that the profits of a whole trip may be consumed by a few days' extra delay. Moreover, the expense per ton of carrying capacity is much greater for an ocean-going boat than for one used in interior waters. The model, also, and the method of handling is different. This difference in cost tends to neutralize any advantage gained in the use of artificial channels by ocean-going boats."

The value of a ship canal from Boston Harbor to Narragansett Bay, as now surveyed by the Army engineers and as herein described, can only be estimated by consideration of the following questions:

1. How much of the existing seagoing commerce said to pass eastward through the Vineyard Sound annually to the amount of 25,000,000 tons would use the canal?

2. What would be a corresponding reduction in the cost of freight?

3. How much of the loss of life and property annually occurring to the seagoing traffic around Cape Cod would be saved?

4. How much new commerce would originate from the intracoastal waterways system?

5. How much benefit would accrue to industries located on or near the route of the proposed canal?

6. How much industrial development might result on or near the route of the proposed canal?

7. What traffic the canal might acquire in distribution and collection of the future ocean commerce of Boston?

The answers to all these questions must be largely conjectural and none of them admit of definite determination.

In attempting any expression in regard to them the commission calls attention to the very short time available for its consideration of this important subject. The commission was organized on April 3 and it is required by the resolve to report in print to the general court on or before May 1, 1911.

The commission under these circumstances can hardly hope to do more than set forth fairly and clearly what the project of a Boston-Naragansett Bay Canal consists of and what it finds to be the present attitude of the public in regard to it.

From the information before us, all of which has been referred to in this report, we find:

1. It is doubtful as to what extent seagoing steamers, both cargo and combined cargo and passenger vessels in the coastwise trade, would use the canal.

2. Sailing vessels would not use this canal under ordinary weather conditions and on account of the cost of towage would not use it except under extraordinary circumstances.

3. It is probable that a fair proportion of the present coal barge traffic around the cape would use the canal.

4. The possible saving on coal freight to Boston harbor would not exceed 5 cents per ton on possibly 4,000,000 tons.

5. If sailing vessels will not use the canal and only a portion of the barge traffic will use it, a part only of the loss of life and property incurred in navigation around Cape Cod would be saved by the construction of the canal.

6. It is probable that there would be some coal brought to Boston in box or other cheap barges which can not now take the outside route. There would be a saving in freight on this traffic.

7. There would be some benefit to local industries and inhabitants of towns on or near the route of the canal by the introduction of competing water transportation.

8. As to the possible industrial development on the route of the canal, there is no doubt that additional sites would be available, having water transportation, but it must be remembered that the State already includes much property yet unused having these advantages.

The Army Engineers estimate the cost of construction of the Boston-Taunton ship canal at $40,047,000 and the annual cost of maintenance at $836,000. If the State contributes the right of way at $900,000 and expends say $1,000,000 on terminals, its total outlay would be $1,900,000 in addition to the cost to the Federal Government.

The conditions of transportation may so change in the future as to make such a canal desirable and necessary, but the facts as they now appear do not warrant this commission in advocating the present construction of the proposed canal. We recommend that the harbor and land commissioners be instructed to include in its annual report each year such statistics and data as may be gathered concerning the progress of American waterways, both completed and projected, and especially of such waterways as may have reference to or bearing upon the commerce of New England.

Very respectfully,

Clarence W. Barron, *Chairman.*
Loyed E. Chamberlain.
Bernard J. Rothwell.
Francis T. Bowles.
A. Homer Skinner.
Frank F. Crane.
John J. Martin, *Secretary.*

[Appendix B 1.]

Report of the Transportation Committee of the Providence Board of Trade on the Commercial Value of the Proposed Intracoastal Waterways to Rhode Island.

The Providence Board of Trade having received from Lieut. Col. J. C. Sanford, of the engineer office, War Department, at Newport, a communication relative to the commercial value of the proposed intracoastal waterway, and having had referred to it a similar communication, addressed by Col. Sanford to his excellency Gov. Aram J. Pothier, requested its committee on transportation to consider both. That committee, having made an exhaustive inquiry, reported to Col. Sanford as follows:

The commercial value of the proposed Intracoastal Waterway in Rhode Island, by itself considered and also as a part of the great scheme of inland waterways, is indorsed by the manufacturers and merchants, and appreciated by those who are affiliated with transportation companies doing business within the State. It is, however, the consensus of opinion that the scheme should not be approached nor considered from a Rhode Island point of view only, but rather in connection with the great advantages that are to accrue to a considerable part of New England.

Narragansett Bay is the southern gateway of New England. It has been made so by nature, and through the development of commerce, which, while it has grown to enormous proportions, has far from reached the limit of its possibilities. To what degree that development will extend will depend in a large measure upon the action of Congress in dealing with the Intracoastal Waterway proposition. The Federal Government is about to begin work of such magnitude in the harbor of Providence that it will give a decided impetus to the commerce of the port, and that improvement, together with the proposed Rhode Island waterway, will make Providence one of the foremost ports on the Atlantic coast, if not the principal one of New England.

Already Providence is a great commercial distributing point. Under the contemplated harbor improvements, and aided by the Intracoastal Waterway, it will be the receiving and shipping port for eastern Connecticut, middle Massachusetts, western New Hampshire, and Vermont, not only for the reason that it is geographically the key to that large and greatly populated territory with its immense manufacturing and

general business interests, but because from Providence is afforded quick communication by rail to all the interior points. Freight to and from ports lying to the south of Rhode Island are now conveyed without being subject to the hazards of the shoals of Vineyard Sound and the peril of the lee shore of Cape Cod. The loss of three barges with 17 lives on the Peaked Hill Bars, near Provincetown, on January 10, illustrates, and forcibly, what that peril is. Moreover, the shorter sail, or tow, annihilates time, eliminates cost to the shipper, and ultimately benefits the consumer.

GENERAL WATERWAY SCHEME APPROVED.

The Intracoastal Waterway, which is to eliminate for vessels of light draught and bottoms under tow the dangers of Point Judith, will greatly increase the commerce of Narragansett Bay and benefit the greater part of New England. For these cogent reasons, as already stated, the opinion prevails in Rhode Island that the necessity for the construction of the Intracoastal Waterway should be considered on the broad plane of general utility, rather than that the discussion of the subject be limited to that portion of the work which is to be prosecuted within the confines of the State. This, without waiving the immense benefits which would accrue to the business and affairs of the people of the State, should it be deemed advisable by Congress to build the Rhode Island section before considering the other and southern links of the waterway.

Rhode Island stands ready to do its part in a most practical manner in furtherance of the work of the War Department and Congress in constructing the Intracoastal Waterway. Providence and the other municipalities lying upon the shores of Narragansett Bay will undoubtedly do their share in providing the essential terminal facilities which the development of the waterway will require.

POPULATION OF THREE MILLION TO BE BENEFITED.

In reply to the specific interrogatories:

(*a*) "What area and what population would be benefited by the proposed Rhode Island link?"

Specifically and assuredly Rhode Island in its entirety; eastern Connecticut, middle Massachusetts, western New Hampshire and all of Vermont—the territory now reached by the various ramifications of existing railroad systems radiating from Providence and those which must ultimately be constructed to care for the increase of commerce which the Intracoastal Waterway will bring to Narragansett Bay. In round numbers, this population is placed at 3,000,000, Boston, Worcester, Fall River, Springfield and the other large manufacturing centers of Massachusetts as well as those of southern New Hampshire being included, as all are in direct rail communication with Providence, where large freights arriving on bottoms are now received from New York and several of the principal ports on the South Atlantic coast.

(*b*) "What is the approximate total amount of freight carried to and from this area (Rhode Island) annually?"

EIGHTEEN MILLION TONS OF FREIGHT TRANSPORTED IN RHODE ISLAND.

The total number of tons of freight transported by rail and water in Rhode Island in 1909 was 18,000,000 tons. More than 95 per cent of the finished products of Rhode Island manufacturing establishments is shipped out of the State, and, to a very great extent, by rail.

The value of these manufactured products in 1909 was $275,000,000, and of this great productive record Providence contributed to the extent of $125,000,000.

(*c*) "What proportion, approximately, of the above amount is now carried by water?"

Fully 5,000,000 tons. Recourse to the report of the harbor master at Providence determines that the annual arrivals at that port, including commodities bound for Phillipsdale and Pawtucket on the Seekonk River, are in excess of 3,000,000 tons. The general merchandise by steamers approximates 500,000 tons. The bulk of the remaining 2,500,000 tons arrives by steam colliers, barges under tow, and sailing vessels, although the latter have been steadily dropping out of the commerce of the port, a sure indication that an Intracoastal Waterway would bring an increased barge business to the bay. Below Providence the amount of water-borne freight is considerable. Foremost is the business which pertains to Fall River, Mass., which in 1909 had a water traffic of nearly 1,400,000 tons. Newport had approximately 240,000 tons. Taunton River had approximately 127,000 tons. Warren and Bristol had approximately 86,000 tons. East Greenwich, Coweset, and Wickford had approximately 40,000 tons. Westerly had approximately 55,000 tons last year, about the same as in 1909, making a total of 4,948,000 tons arriving annually by water through

Narragansett and Little Narragansett Bays. A safe estimate, making allowances for miscellaneous freight perhaps not accurately reported, would be 5,000,000 tons per year.

APPROXIMATELY SIX HUNDRED THOUSAND TONS FINISHED PRODUCTS SHIPPED OUT BY WATER.

The out-going water freight is comparatively small in tonnage, as the shipments are largely confined to the finished products of Rhode Island and other New England industries Approximately the amount of freight shipped out in 1909 was 600,000 tons, of which, to be exact, 362,776 tons were shipped from Providence by steamers.

The amount of coal arriving in Providence Harbor in 1910, as given by the harbor master, was 2,979,336 tons. The natural inference is that this represents a great increase over the coal receipts of that harbor reported in 1900 for the year 1899, practically a decade ago. Such, however, is not the case. The arrivals in Providence Harbor for that period (1899) aggregated 2,160,979 tons, out of a total tonnage of 2,973,503 tons.

PROVIDENCE GAINING STEADILY AS A COAL PORT.

On the face of these figures it would appear that Providence as a coal receiving and distributing port was making no material headway. The fact is, however, that the port is steadily gaining with respect to coal. For years Providence was the coal-distributing port for a great portion of interior New England, as many hundreds of thousands of tons of coal were regularly and annually unloaded at Providence and conveyed by rail to Worcester and other prominent manufacturing centers out of the State. About five years ago these rail shipments from Providence ceased, since when the coal business which was formerly done via Narragansett Bay has been conducted by all-rail transportation direct from the mines. So thoroughly has the all rail system of handling coal supplanted the former coal business of Narragansett Bay and Providence Harbor that carload lots are actually brought by rail to some of the Providence mills. While losing this great interior New England coal business, Providence has steadily gained in local traffic, so that the annual volume of coal traffic has reached the comfortable total of approximately 2,339,842 tons. One authority places it at approximately 2,660,000 tons.

WATER-BORNE COTTON FREIGHTS MATERIALLY LESSENED.

Providence River and Harbor has lost almost wholly the large cotton shipments which erstwhile came by water. Formerly sailing vessels brought thousands of bales of cotton to Providence annually. To-day the arrivals are confined to shipments by steamers. They are consignments forwarded from three of the seaboard cotton depots, and constitute parts of general merchandise cargoes. Warren formerly received the bulk of its cotton by water; to-day it has none of that class of water-borne freight. On the west shore of the bay one coal concern reports the receipt of 1,000 tons of coal by water in 1910, as against 4,000 in previous years, the loss of water-borne freight being due to all-rail shipments.

(*d*) "What is the estimated proportion that would be carried by water if the Rhode Island link is constructed?"

Transportation agents of recognized ability and authority assert that this question is hardly possible of being satisfactorily answered. All agree, however, that the construction of the Rhode Island link would result in a very large quantity of merchandise being forwarded via the waterway, not only in the form of coal, cotton, and other raw material, but as the finished products of Rhode Island and New England industries destined for the cities of the South and West to be reached by the intracoastal waterway, and which could be shipped through the canal at much less expense to the consumers.

HIGH-CLASS SERVICEABLE COAL BARGES REQUESTED.

Local coal men do not agree that coal shipments to Narragansett Bay would be materially affected, unless a type of barges was adopted superior to the "square-enders" and offering less resistance when under tow than the general type of small capacity craft now in vogue. If an improved type of barge was adpoted for the waterway, and shipments via the canal were regular and systematic, then a considerable portion of the coal traffic could be regularly maintained, the waterway being kept open to traffic during the winter months, the coal men would, they say, not be obliged to stock up heavily during the summer months to meet possible cessation of water traffic when the bay became icebound. The waterway, under the conditions named, would eliminate all danger of a coal famine and save to the coal men the interest on investments in large stocks.

SAVING ON CANAL FREIGHTS EQUAL TO FIFTY PER CENT.

(*e*) "What is the estimated reduction in freight rates that could be expected on various kinds of freight and at various points in the above area if the Rhode Island link is built?"

It is the opinion of those well posted on the subject of freight transportation that a reduction of from 25 to 50 per cent would reasonably be expected and then leave a comfortable margin of profit.

(*f*) "What saving in time per boat and per year could be expected between Long Island Sound and Narragansett Bay if a canal between the two were built; also what saving in insurance? Please give instances of delay and causes of delay known to you."

(1) The time saved per boat and per year can not be stated. Different boats experience different conditions. Again, the number of trips per boat to these waters vary. Delays are due to stress of weather, fogs, and ice. A single instance: Several coal barges bound for Providence were tied up at New London for 21 days. This was in the fall of 1910. For three weeks the sea was so bad off the Rhode Island coast that it was impossible to tow the barges around Point Judith. These craft were generally of the "square-end" type, which would be unable to withstand severe pounding and racking. Delays of from three days to a week because of bad seas and heavy fogs are of frequent occurrence. Were there an inland waterway route these barges could have come forward without any delay whatever.

WOULD BE SATISFACTORY REDUCTION IN COST OF INSURANCE.

(2) Insurance: Leading insurance authorities agree that there would be but little saving on insurance if the risks were confined to shipments via the Rhode Island link, but should the intracoastal waterway be extended to Boston, thereby eliminating the dangers incident to Vineyard Sound Shoals and the lee shore of Cape Cod, the saving on insurance would be from 10 to 20 times greater than that pertaining to the business of the Rhode Island link. Present insurance rates are declared to be so low that but little paring down could reasonably be expected for the Rhode Island link.

(*g*) "What development of manufacturing enterprises along the line of the canal could be expected?"

As the cost of transporting building materials would be much reduced, and freights on incoming raw materials, as well as on finished products shipped out would be low, capital would be attracted and cotton and woolen mills would be erected. Rhode Island is stronger on textiles than on any other line or lines of manufacture, and the natural trend would be in that direction. Incidentally the building of these mills would give further impetus to steam and electrified railroads. Both forms of land transportation would be developed to the extent of coupling the new mills with existing lines of rails.

LIGHT-PACKAGE FREIGHT TRAFFIC INCREASE IS PROBABLE.

(*h*) "What type of boats, draft and length, would probably be used on the canal, considering both boats in existence and those to be built in the future?"

The opinion prevails among Rhode Island manufacturers and those well informed in matters pertaining to water transportation that the process of evolution is in such a state, involving as it does the application of the turbine, the gas and gasoline engines, to practical maritime commerce, that it is an open question what type of motor power or what type of boat would best meet the requirements of the canal and the business that it is to accommodate. Whether the boats travel in an individual capacity under their own steam or are employed to tow barges, propellers must be relied upon. Not only must sufficient depth of water be allowed that the screws may obtain requisite hold, but the walls of the canal must be made of sufficient strength to withstand constant washings due to the churning of the water. It is held that to minimize injury to the canal walls the "square-enders" should not be tolerated, but that barge traffic should be limited to bottoms built so as to insure the least possible resistance when under tow. These crafts and barges, it is held, should be of such length as to provide for sizable cargoes, thereby minimizing cost of transportation and insuring the commercial utility of the canal. The depth of the boats is considered a matter which should be dealt with by those thoroughly conversant with the details of operating canals. It is assumed that boats of much lighter construction than those sent outside will be constructed for the canal. With such a line of crafts the building up of a large light-package freight traffic to Philadelphia, Baltimore, and other ports easy of access from Rhode Island is considered feasible and probable.

WHAT IT COSTS TO TEAM LOCAL FREIGHTS.

(*i*) "What is the distance and cost of haul from railroad terminal to business center in your locality?"

There is no appreciable distance, as the steam railroads pass through the heart of the city of Providence and close by the greater part of the wholesale and retail business and adjacent to most of the manufacturing plants. Practically the same conditions apply to every city and large town in Rhode Island. The cost of haulage is from 2½ to 4 cents per hundred pounds, according to the character and bulkiness of the freight.

(*j*) "What is the distance and cost of haul from public water terminals to business center at your locality?"

From 2½ to 4 cents per hundred pounds. The distance from the water terminals to the business center varies from one-half to a mile and one-half, the latter haul including the dock of the Providence Line, so-called, and that of the Merchants & Miners Transportation Co. The haul to Olneyville center is 3 miles; to the North End center 4 miles; and to Manton center 4¼ miles.

DEMAND FOR WHARF STORAGE AND BONDING FACILITIES IS PRESSING.

(*k*) "What is the approximate amount of package freight, and what are the facilities for wharf storage and delivery to consignees at your locality?"

Confining this question to Providence: The package freight business, incoming, in 1909 was a little in excess of 450,000 tons. This embraced 416,312 tons of general merchandise by steamers. The outgoing merchandise by steamers was 362,776 tons. There are no facilities for wharf storage in Providence other than that offered by the three steamship lines, but these will soon be provided. There is no public dock and no public or bonded warehouse at or near the docks, but there will be ample public docks and a bonded warehouse. (See reply under caption "*n*.") The only facilities afforded for delivery to consignees are those by teaming, such as are incident to a general steamship business on privately owned docks. Generally these accommodations suffice for the handling of merchandise, as quick deliveries are made. But in times of congestion of traffic considerable delay is experienced. Local merchants and consignees are emphatic in their assertions that a bonded warehouse at the water front is one imperative necessity and should be considered in connection with the subject under discussion.

LACK OF MERCHANT MARINE CAUSE OF ALL-RAIL SHIPMENTS.

(*l*) "When railroad rates are higher than water rates, and the proportion of bulk freight carried by rail is greater than that carried by water, ascertain, if possible, the cause of the greater shipment by rail."

Rail shipments to this territory far exceed the water-borne freight. The reason for this is that greater expedition is secured for all-rail shipments; while there is lamentable lack of bottom to carry by water. Rates by rail are acknowledged to be much higher than those by water; but the uncertainty of securing water-borne consignments on time, because of a lack of merchant marine and the liability of delays through storms and stress of weather, causes a preference for all-rail transportation. Cotton men, in particular, say that they order their consignments forwarded by rail, even at greater cost, rather than risk delay of arrival.

(*m*) "Would the difficulty under question (*l*) be eliminated if the Rhode Island Canal were built?"

In a measure, yes. Much would depend upon the size and character of the boats sent through the canal, and the keeping of the waterway open to continuous service. Were rapid transit and plenty of bottoms assured, there would without question be a big increase of the water-borne freight business of Rhode Island, hence a big impetus would be given to the general freight traffic of the southern gateway of New England. There would be restoration to a considerable extent of the cotton business now lost to the port, and vast quantities of coal for interior New England would be sent to Providence in bottoms. This would bring more capital for the upbuilding of the merchant marine to care for the increased traffic. There are periods when the lack of our merchant marine is painfully felt; notably so in 1907, when business was so brisk all over the country that every railroad was swamped with freight and congestion was prevalent. An active merchant marine could have greatly ameliorated those conditions and have aided in a general forward movement of freight. At that time Pawtucket-bound freight laid on the docks at Providence for two weeks. There were no cars to be had by which this freight could be forwarded and there were no lighters for the short tow up the Seekonk River to Pawtucket—but 4 miles from the steamship docks.

RHODE ISLAND MAY DONATE CANAL SITE AND CONSERVE BUSINESS INTERESTS.

(*n*) "What assistance could reasonably be expected from the State or municipalities, either toward the construction of the canal itself or toward the development of suitable terminal facilities?"

Very substantial and practical aid could reasonably be expected from the State of Rhode Island. The Commonwealth holds fee in all tide-flowed grounds. The proposed layout follows a line of ponds, bogs, marshes, swamps, and water-covered land, a very considerable part being tide-flowed. It has been roughly estimated that an expenditure of $500,000 would suffice to secure the right of way for the canal.

Providing Congress directs the building of the canal and will make the necessary appropriation recommended by the War Department, Rhode Island will probably not only purchase, but will donate the canal site to the Federal Government. It will furthermore see to it that the land on either side of the canal is reserved for the proper operation of the waterway and that at either end of the canal land will be kept under State control for use as terminals, industrial sites, and railroad connections.

STATE WILL ESTABLISH PUBLIC DOCK NEAR FIELDS POINT.

So much for the future. Now for the present. The electors of Rhode Island approved the issue of $500,000 in bonds and authorized a harbor improvement commission to purchase and improve lands for public docks. The bonds have been issued and the commission is about to move. Originally it was intended to establish a public dock on the East Providence shore and one at Pawtucket. The East Providence site has been temporarily abandoned. Instead one is favored at Providence, on the west shore of the harbor. The advantage this last site has over the other is that it is but a short distance removed from the tracks of the New York, New Haven & Hartford Railroad Co., affording quick rail communication with the West, North, and East, and it will be not far distant from the proposed layout of the Grand Trunk system, which is soon to build a line to Providence to connect with its great western and Canadian lines, providing thereby an ocean-to-ocean route. It will also have the advantage of being near the proposed public docks of the city of Providence, which will be readily reached by the steam and electric railroads and easy of access via Allens Avenue, the coming commercial highway of that city.

Rhode Island is also contributing to the improvement of the harbor of Providence through the work of the harbor improvement commission and may be counted upon as an earnest ally in anything which will speed the building and demonstrate the utilitarian character of the Intracoastal Waterway.

A public dock will be provided Pawtucket, by early purchase of site and the development of the property. Eventually another such dock will be obtained at East Providence, and these three, together with those which Providence will provide, will secure all the terminal facilities which the War Department or Congress may require as an adjunct of the Rhode Island link of the Intracoastal Waterway.

PROVIDENCE TO IMPROVE WEST SIDE OF HARBOR LINE.

Providence is so far removed from the northerly terminus of the waterway that it could not reasonably be asked to contribute anything beyond moral support to the building of the Rhode Island link, but the city will do its share and more in another and thoroughly practical manner.

Working in conjunction with the Federal authorities, the State and the city of Providence will expend practically $1,000,000 for the improvement of its harbor. This work will include the intersection of Fields Point and the removal of all that sand spit and the contiguous shore, northerly and southerly, so as to provide a straightaway channel 25 feet deep at mean low tide from the lower anchorage to the bay. That this cut may be made and the channel kept free, a sea wall will be built for a distance of 2,900 feet.

The city council has appropriated $450,000 for this betterment, of which sum $63,000 has been expended in the acquirement of adjacent land. It was originally intended to provide for the construction of a sea wall, which would cost something like $200,000; but upon reflection the decision was arrived at to recommend the building of one of a more permanent character—one which would stand for 100 years or better and serve as the outlying feature of a public dock at which ocean steamships might lie. Such a wall will cost not less than $350,000, and such a one will be built. It will practically be a continuation of the splendid sea wall to the northerly, just constructed by the Providence Gas Co., and in time it can and will be extended

southerly without limitation to provide additional public docks. This will give Providence public dock accommodations unexcelled east of New York, and open the door to general commercial marine competition in lieu of the bottled-up condition of the harbor which now exists through private ownership, confined almost wholly to one transportation corporation. With the establishment and occupation of the public docks must necessarily be provided the bonded warehouse, as these features of mercantile commerce are inseparable.

[Appendix B 2.]

LETTER OF THE GOVERNOR OF RHODE ISLAND.

January 24, 1911.

To the honorable the General Assembly:

I have the honor to transmit to you herewith a letter addressed to the governor from the secretary of the Providence Board of Trade, accompanying a copy of a resolution adopted by the executive council of that body on January 17, 1911, requesting the governor to urge upon the general assembly the passage of an act authorizing and empowering a State commission to secure rights of way across the State of Rhode Island for an intracoastal waterway, with approaches, substantially along the route of the survey made by the United States engineers, with a view to deeding the same to the Federal Government.

The board of United States engineers having charge of this survey has completed its plans for a sea level waterway at an estimated cost for construction of from $15,000,000 to $22,000,000. Its report will shortly be made to the War Department, and upon the evidence of public interest and benefit which said report reveals will depend largely the light in which the Federal Government will view this projected undertaking.

Believing that this projected waterway across Rhode Island, not only of itself but as a link in the great chain of protected waterways contemplated extending from Boston Harbor to Florida, means more for the future of the manufacturing and commercial interests of Rhode Island and southern New England and to the country at large than is possible of conception to-day, I would respectfully urge that the suggestions made in this resolution of the executive council of the Providence Board of Trade be accorded most careful and mature consideration by this general assembly, and that steps be taken without delay to determine the advisability and expediency of the course of State action therein outlined.

A similar proposition is under serious consideration by the New Jersey Legislature with reference to the canal link across that State. It is proposed there that the State shall purchase liberal quantities of the land on either side of the canal route, such land to be kept under State control for use for terminals and approaches, docking facilities, and railroad connections. The legislature of that State passed an act in 1910 carrying with it authority to issue bonds and acquire water-front property by purchase or condemnation for the erection of docks and terminals. It has already become evident that the demands for riparian lands along the waterway and the resulting increase in their value will enable the State to cover their cost many times and to realize a direct profit on its investment. I believe that a similar opportunity presents itself to the State of Rhode Island worthy of close attention.

Pending the consideration of this matter I would respectfully ask that this communication, with the accompanying resolution of the executive council of the Providence Board of Trade, after a reading thereof in both houses, be referred to the committee on executive communications.

Very respectfully,

Aram J. Pothier, *Governor.*

[Appendix C 1.]

The question of the increased channel width occupied by a steamer or a tow in rounding a bend was considered, with a view to determining which of the several formulae for increasing the width of a canal at bends might be best.

Formulae in general use are as follows:

$$(2)\quad D=4\,(R-\sqrt{R^2-\frac{(L)^2}{(2)}}$$

$$(3)\quad D=60-.005\,R$$

$$(4)\quad x=\sqrt{L^2+(w+2R)^2}-2R$$

in which D=the increase in width necessary,
L=the length of the ship considered,
R=the radius of the curve,
w=the bottom width of the canal,
x=the total width necessary at the curve.

Formula 2 was deduced by M. Saint-Yves. (Proceedings of the Sixth International Congress of Inland Waterways, pt. 1, p. 77.)

Formula 3 is from the report of the board of engineers for deep waterways.

Formula 4 is from the Sixth International Navigation Congress, pamphlet by Mr. Derome.

The results given by these formulae are discordant. It was therefore deemed best to make a set of independent observations. Though due to conflicting tidal currents and congestion of traffic, the location chosen, at the Battery, New York, is not well suited to observations of this character, it was the best then available and a number of fairly typical runs were observed, sufficient to afford a fairly satisfactory analysis. There was also available a record of similar observations made in 1905 on vessels navigating the St. Marys River, which are free from variations of speed and course due to currents and passing vessels.

There were in all 60 sets of observations made during a period of 4 days of 8 hours each. While it was desired in the New York observations to include vessels of various types and sizes, special effort was made to observe the larger and more unwieldy units, such as car floats and tows of scows. Upon plotting the positions of the vessels and tows observed, it was found that on account of the various interruptions and varying influence of the tidal currents the vessels did not maintain a uniform rate of speed, nor did they follow a course of uniform curvature. Hence it was necessary to confine the analysis to short stretches, where a regular curve could be passed through the plotted positions of the vessel's bows. It is evident that the increase of width is made necessary by the oblique position with respect to the course taken by the unit when moving along a curved sailing line.

Neglecting wind and current effects, the extent of the departure of the bow and stern from the sailing line, assuming a fairly uniform speed such as would be required of vessels using a canal, is dependent upon two factors, i. e., the length of the unit and the radius of the curve. For tug boats and twin-screw propeller boats, the speed undoubtedly does enter, but if the increase of width be made sufficient for a long unit, such as a tug with barges alongside and in front, it will suffice for shorter units moving at greater speed.

Of the 60 sets of observations taken at the Battery, only 10 were sufficiently free from irregularities due to changes of course and speed to be useful. From an analysis of these 10 sets and of the St. Marys River observations, the following formula for the increase of channel width required on a curved course was deduced, viz:

$$D=\sqrt{R^2+L^2}-R$$

in which D=increased width of channel occupied,
R=radius of curve,
L=length of ships or unit.

It is assumed that the point of pivot or gyration is at the bow, with the center line of the ship, i. e., the keel, tangent to the curve.

The following table shows a comparison of the observed increase of channel width used and the theoretical necessary increase as deduced from the various formulae:

Type of unit.	Length of boat.	Radius of curve.	Increased channel width occupied.	Correction for current.	Increase required.	Increase as computed by formulæ—			(4)[4]	
						(1)[1]	(2)[2]	(3)[3]	Total width.	Increase.
Observations at Battery, New York.										
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Tug and one barge	220	3,042	4.6	....	4.6	7.9	7.6	44.8	128.9	3.9
Steam lighter Leader	110	2,220	2.0	....	2.0	2.7	2.8	48.9	126.3	1.3
Tug and three barges	500	1,705	156.0	84.0	72.0	71.8	74.0	51.5	160.1	35.1
Tug and two car floats	300	6,286	35.0	26.0	9.0	7.1	7.2	28.6	128.5	3.5
Steamship Matanzas	360	1,315	22.0	....	22.0	48.4	49.6	53.4	148.4	23.4
Tug and two car floats	330	3,320	47.4	36.5	10.9	16.3	16.4	43.4	133.0	8.0
Do	250	1,950	9.4	....	9.4	16.0	16.1	50.2	132.8	7.8
Do	330	2,133	60.1	34.6	25.5	23.1	25.6	49.3	137.4	12.4
Do	330	2,142	65.3	45.8	19.5	25.2	25.6	49.3	137.3	12.3
Do	250	2,400	12.0	....	12.0	13.0	13.2	48.0	131.3	6.3
Observations in St. Marys River.										
Steamer Sylvania	524	3,000	46.0	....	46.0	45.4	46.0	45.0	147.3	22.3
Steamer H. W. Smith	434	2,333	36.0	....	36.0	40.2	42.4	48.3	144.6	19.6
Steamer R. W. England	382	2,333	37.0	....	37.0	31.1	31.6	48.3	140.1	15.1
Do	382	2,166	36.0	....	36.0	33.4	34.0	49.2	141.4	16.4
Steamer Zenith City	405	2,000	46.0	....	46.0	40.5	41.2	50.0	144.8	19.8
Steamer Bransford	435	3,666	25.0	....	25.0	25.7	26.0	41.7	137.6	12.6
Steamer Princeton	474	2,500	42.0	....	42.0	44.5	45.2	47.5	146.8	21.8
Steamer Bransford	435	2,166	40.0	....	40.0	43.2	44.0	49.2	146.1	21.1
Steamer Yuma	340	2,333	29.0	....	29.0	24.6	24.8	48.3	137.1	12.1
Steamer John Crerar	257	1,834	16.0	....	16.0	17.9	18.0	50.8	133.7	8.7
Steamer J. C. Wallace	552	2,000	63.0	....	63.0	74.7	76.8	50.0	161.7	36.7

[1] $D=\sqrt{R^2+L^2}-R$ [2] $D=4\left(R-\sqrt{R^2-\left(\frac{L}{2}\right)^2}\right)$ [3] $D=60-.005\ R$ [4] $x=\sqrt{L^2+(w+2R)^2}-2R$

It is evident that formulæ 1 and 2 give results most nearly in accord with the observations.

[Appendix C 2.]

Waterways of New York, New Jersey, Pennsylvania, and Delaware directly tributary to the New Jersey section of the proposed intracoastal canal.

[Tonnage and valuation from Report of Chief of Engineers, U. S. Army, 1910.]

Stream or waterway.	Navigable length.	Short tonnage.	Value.
	Miles.		
Bronx River	[1] 3	520,215	$1,272,266
Harlem River	8	12,822,885	369,009,686
Hudson River			
Newtown Creek	4	5,113,628	253,003,661
Raritan Bay (including South River, Raritan River, Cheesequake Creek, Keyport Harbor, and small per cent of Arthur River)	24	8,283,839	107,829,053
Shoal Harbor and Compton Creek	1	37,761	490,975
Arthur Kill	12	9,504,090	131,950,111
Newark Bay and Passaic River	16	2,650,809	164,800,203
Shrewsbury River	17	1,959,920	7,320,000
Jamaica Bay	12	977,266	3,846,574
Elizabeth River	2.75	30,242	217,877
Woodbridge Creek	2	116,459	587,164
Mantau Creek	11	125,605	1,025,525
Rancocas Creek [1]	16.6	462,971	(3)
Raccoon Creek	9.75	58,107	719,750
Wilmington Bay, Del	6	805,447	64,290,775
Delaware River	60	24,667,671	1,327,869,862
Delaware & Raritan Canal [2]	66.9	400,000	(3)
Delaware Division Canal [1]	60	240,625	(3)
Lehigh Canal [1]	48		
Schuylkill Canal [1]	90	54,354	(3)
Total	464	68,831,894	2,434,233,482

[1] Preliminary Report of the Inland Waterways Commission, 1908.
[2] Report of committee appointed to investigate Delaware & Raritan Canal to senate of New Jersey, April 18, 1911.
[3] Not given.

Principal cities tributary to the New Jersey section of the proposed intracoastal waterway.

[Population from census of 1910; statistics from census of 1904.]

City.	Population.	Wage earners.	Number of establishments.	Capital involved.	Cost of materials.	Value of products.
Bayonne	55,545	7,057	58	$50,297,000	$46,984,000	$60,634,000
Camden	94,538	12,661	298	31,992,000	20,423,000	33,587,000
Chester	38,537	7,061	131	22,070,000	10,422,000	16,645,000
Elizabeth	73,409	12,335	124	23,564,000	16,982,000	29,301,000
Harrison	14,498	4,040	41	11,389,000	3,629,000	8,409,000
Hoboken	70,324	7,227	279	11,777,000	6,580,000	14,077,000
Jersey City	267,779	20,353	628	82,395,000	48,799,000	75,741,000
Newark	347,469	50,697	1,600	119,028,000	80,689,000	150,055,000
New Brunswick	23,388	4,590	71	10,393,000	4,158,000	8,917,000
New York	4,776,883	464,716	20,839	1,042,946,000	818,029,000	1,526,523,000
Passaic	54,773	11,000	95	28,611,000	13,110,000	22,783,000
Perth Amboy	32,121	3,950	53	11,583,000	30,316,000	34,800,000
Philadelphia	1,549,008	228,899	7,087	520,179,000	333,352,000	591,388,000
Trenton	96,815	14,252	312	41,623,000	17,692,000	32,720,000
West Hoboken	35,403	3,562	95	6,018,000	3,122,000	5,947,000
Wilmington, Del	86,411	13,554	247	33,227,000	18,173,000	30,390,000
Total	7,617,901	865,954	31,958	2,047,092,000	1,472,460,000	2,641,917,000

Rivers and harbors tributary to the section affected by the construction of the intracoastal waterway south of the New Jersey section as far as Beaufort, N. C.

Stream or waterway.	Navigable length.	Short tonnage.	Value.
	Miles.		
Alloway Creek, N. J	10	17,565	$611,500
Cooper Creek, N. J	9	244,222	2,073,188
Delaware River [1]	60	....	....
Christiana River, Del	6	815,245	64,707,575
Smyrna River, Del	9	203,580	4,979,740
St. Jones River, Del	21	113,550	6,055,129
Appoquinimink, Del	8¼	29,250	1,786,400
Murderkill River, Del	9	26,067	1,324,700
Mispillon River, Del	12	187,356	4,085,500
Broad Creek, Del	7½	(2)	(2)
Susquehanna River, Md	5½	41,730	475,933
Patapsco River	11	8,415,220	107,206,559
Elk River, Md	16	55,718	346,733
Chester, Md	39¼	54,618	4,121,412
Choptank, Md	46	234,920	19,357,086
Warwick (Secretary) Creek, Md	2	68,017	3,618,998
Pocomoke, Md	28	74,459	5,354,154
La Trappe (Dividing) Creek, Md	3	15,394	1,045,114
Manokin, Md. [3]	12	32,076	(2)
Wicomico, Md	23	224,983	17,000,080
Patuxent, Md	46	(2)	(2)
Nanticoke, Del	36	135,241	8,702,054
Potomac, D. C. and Va	113	2,915,132	51,620,428
Anacostia	8¾	450,213	
Rappahannock	106	397,210	6,462,912
York River, Va	41	85,139	6,220,752
Mattaponi River, Va	39	86,087	1,655,737
Pamunkey, Va	62	59,961	514,144
James River, Va	104	476,465	32,163,423
Chickahominy, Va	32	(2)	(2)
Appomattox, Va	11	38,489	630,250
Occoquan Creek, Va	6	32,701	266,917
Nandua Creek, Va. [3]	4	5,119	(2)
Aquia Creek, Va. [3]	7½	19,000	(2)
Carters Creek, Va	2½	68,842	1,456,728
Nomini Creek, Va	6	27,285	1,138,998
Urbana Creek, Va	4	31,877	1,068,550
Pagan, Va	12	84,424	(2)
Nansemond, Va	18	96,251	(2)
Elizabeth, Va	25	10,972,999	[4] 43,958,080
North, N. C	13½	195,237	(2)
Perquimans, N. C	26	27,383	552,350
Chowan, N. C. [3]	50	(2)	(2)
Meherrin, N. C	11	14,802	1,125,260
Blackwater, Va	13	5,413	866,080
Nottoway, Va. [3]	12	(2)	(2)
Alligator, N. C. [3]	30	(2)	(2)
Roanoke, N. C	129	68,113	1,383,905
Scuppernong, N. C	23	20,556	556,401
Fishing Creek, N. C	17½	2,300	22,600
Pamlico and Tar, N. C	[3] 108	310,542	5,560,166
Contentnia Creek, N. C	50½	24,679	486,980
Neuse, N. C	136	402,428	7,472,530
Trent, N. C	38	156,530	3,417,045
Chesapeake & Delaware Canal [3]	14	683,086	(2)
Chesapeake & Ohio Canal [3]	185	225,142	(2)
Dismal Swamp Canal	[3] 22	361,665	5,670,070
Albemarle & Chesapeake Canal	9	195,237	(2)
Newbern & Beaufort [3]	3	81,770	(2)
Fairfield Canal [3]	4	(2)	(2)
Chesapeake Bay	220	....	....
Total	2,135¾	29,611,391	427,122,161

[1] Statistics incorporated in New Jersey section.
[2] No statistics.
[3] Preliminary Report of the Inland Waterways Commission, 1908.
[4] For 5,805,268 tons.

Tonnage and vaulation from Report of Chief of Engineers, U. S. Army, for 1910.

Principal cities and towns tributary to the section affected by the construction of the Intracoastal Waterway south of the New Jersey section as far as Beaufort, N. C.

[Population from census of 1910; statistics from census of 1904.]

City.	Population.	Wage earners.	Number of establishments.	Capital.	Cost of materials.	Value of products.
Baltimore	558,485	65,224	2,163	$148,764,000	$81,014,000	$151,547,000
Newbern, N. C	9,961	762	21	1,233,000	675,000	1,343,000
Newport News	20,205	7,406	25	22,958,000	4,479,000	9,054,000
Norfolk	67,452	3,063	123	4,576,000	3,261,000	5,900,000
Richmond	127,628	12,883	281	31,953,000	13,102,000	28,203,000
Washington, D. C	331,069	6,299	482	20,200,000	7,732,000	18,359,000
Wilmington, N. C	25,748	1,667	55	1,926,000	1,823,000	3,155,000
Total	1,140,548	97,304	3,150	231,610,000	112,086,000	217,561,000

Rivers and harbors tributary to the section affected by the construction of the Intracoastal Waterway north of the New Jersey section as far as Boston, Mass.

[Tonnage and valuation from Report of Chief of Engineers U. S. Army, for 1910.]

Stream or waterway.	Navigable length.	Short tonnage.	Value.
	Miles.		
Taunton River, Mass	[1] 13½	175,599	$750,301
Providence Harbor, R. I		3,814,982	106,141,560
Thames River, Conn	15	522,829	7,619,010
Connecticut River, Conn	[1] 50	614,780	27,162,737
Housatonic River, Conn	[1] 13	81,485	472,088
Mystic River, Mass	6	4,894,088	[2]
Gloucester Harbor, Mass		218,165	[2]
Beverly Harbor, Mass		196,203	[2]
Lynn Harbor, Mass		359,195	[2]
Boston Harbor, Mass	[2]	[2]	[2]
Dorchester Harbor, Mass	5½	251,667	[2]
Weymouth River, Mass	[1] 10⅝	339,351	[2]
Hingham Harbor, Mass		11,086	[2]
Plymouth Harbor, Mass		58,246	[2]
Nantucket Harbor, Mass		28,550	1,251,543
Woods Hole Channel, Mass	1	43,032	2,927,175
New Bedford Harbor, Mass		1,392,802	47,607,190
Sakonet Harbor, R. I		7,385	615,395
Fall River Harbor, Mass		1,331,729	53,541,985
Pawtucket, R. I	4	475,255	5,525,994
Newport Harbor, R. I		239,924	19,071,228
Block Island, R. I		18,668	1,015,319
Pawcatuck, R. I. and Conn	7½	60,724	280,504
New London Harbor, Conn		707,768	80,247,609
Branford Harbor, Conn		40,880	269,773
New Haven Harbor, Conn		1,429,809	97,561,794
Bridgeport Harbor, Conn		1,117,131	39,491,628
Norwalk Harbor, Conn		222,787	2,320,578
Five Mile River Harbor, Conn	1	22,265	420,554
Stamford Harbor, Conn	1	264,615	10,522,311
Southport Harbor, Conn	1	6,912	76,420
Greenwich Harbor, Conn	1	79,727	8,884,960
Westport Harbor, Conn		12,873	50,610
Port Chester Harbor, N. Y	1½	255,067	7,630,200
Mamaroneck, N. Y		106,344	1,260,982
Echo Bay, N. Y		248,180	2,604,150
Port Jefferson Harbor, N. Y		129,365	1,836,550
Huntington Harbor, N. Y	2	43,289	476,414
Glen Cove Harbor, N. Y		7,062	18,000
Total	132	19,793,839	527,654,562

[1] Preliminary Report of Inland Waterways Commission, 1908. [2] Statistics not given.

250 miles from New York to Boston via Long Island Sound and Cape Cod Canal.

Principal cities and towns tributary to the section affected by the construction of the Intracoastal Waterway north of the New Jersey section as far as Boston, Mass.

[Population from census of 1910; statistics from census of 1904.]

City.	Population.	Wage earners.	Number of establishments.	Capital.	Cost of materials.	Value of products.
Boston	670,585	59,160	2,747	$131,563,000	$94,603,000	$184,351,000
Bridgeport, Conn	102,054	19,492	306	49,381,000	22,335,000	44,587,000
Fall River, Mass	119,295	26,836	234	69,375,000	26,096,000	43,473,000
Lynn, Mass	89,336	21,540	431	23,139,000	32,616,000	55,003,000
New Bedford, Mass	96,652	17,855	176	40,410,000	16,091,000	29,469,000
New Haven, Conn	133,605	21,437	490	31,413,000	18,521,000	39,666,000
New London, Conn	19,659	2,554	57	4,590,000	2,527,000	4,710,000
Plymouth, Mass	11,200	2,300	35	7,910,000	8,568,000	11,116,000
Salem, Mass	43,697	5,945	143	9,670,000	7,921,000	12,202,000
Stamford, Conn	25,138	3,341	62	7,526,000	2,330,000	5,890,000
	1,311,221	180,460	4,681	374,977,000	231,608,000	430,467,000

Rivers and harbors tributary to the section affected by the construction of the Intracoastal Waterway north of the New Jersey section, including New York Barge Canal system.

Stream or waterway.	Navigable length.	Short tonnage.	Value.
	Miles.		
Hudson River	[1] 153	[2] 3,254,423	[2] $237,214,824
Erie Canal	[1] 355	[3] 2,385,491	
Champlain Canal	[1] 81	[3] 740,983	
Oswego Canal	[1] 38	[3] 172,228	[4] 66,501,417
Cayuga & Seneca Canal	[1] 25	[3] 164,875	
Black River Canal	[5] 46	[3] 77,331	
Total	698	6,795,331	303,716,241

[1] Report of the Commissioner of Corporations on Transportation by Water, 1909.
[2] Report of Chief of Engineers, 1910.
[3] Special Report on Transportation by Water, Bureau of the Census, 1906.
[4] Report of the Barge Canal Terminal Commission, State of New York, 1911, vol. 1.
[5] Report of New York State Engineer, 1905, vol. 2.

2,300 miles—sailing distance on Great Lakes, St. Lawrence River, and Lake Champlain.

Principal cities and towns tributary to the section affected by the construction of the Intracoastal Waterway north of the New Jersey section and in the State of New York.

[Population from census of 1910; statistics from census of 1900.]

City.	Population.	Wage earners.	Number of establishments.	Capital.	Cost of materials.	Value of products.
Albany	100,253	12,389	1,566	$21,329,000	$11,122,000	$24,992,000
Troy	76,813	21,564	662	23,532,000	11,292,000	28,209,000
Syracuse	137,249	14,917	1,383	31,358,000	14,771,000	31,948,000
Rochester	218,149	33,408	2,616	49,086,000	32,082,000	69,130,000
Buffalo	423,715	43,422	3,902	103,940,000	73,359,000	122,230,000
Whitehall	4,917	403	47	643,000	320,000	597,000
Schenectady	72,826	4,431	388	6,518,000	4,954,000	9,288,000
Rome	20,497	2,653	196	3,738,000	3,723,000	6,094,000
Cohoes	24,709	8,673	316	11,316,000	6,120,000	11,636,000
Haverstraw	5,669	1,174	110	1,306,000	406,000	1,366,000
Hudson	11,417	1,403	144	2,357,000	1,496,000	3,097,000
Kingston	25,908	2,685	344	3,658,000	2,561,000	5,280,000
Lansingburg	....	2,940	127	2,958,000	1,598,000	3,778,000
Ossining	11,480	892	137	1,358,000	885,000	2,068,000
Peekskill	15,245	1,524	153	1,712,000	1,024,000	2,339,000
Poughkeepsie	27,936	3,432	377	5,688,000	3,475,000	6,827,000
Saugerties	3,929	580	117	1,202,000	718,000	1,352,000
Tarrytown	5,600	375	77	468,000	327,000	719,000
Utica	74,419	10,759	733	19,290,000	9,405,000	19,551,000
Watervliet	15,074	1,167	135	1,827,000	850,000	1,809,000
Yonkers	79,803	8,615	387	13,097,000	10,555,000	19,580,000
Total	1,355,608	1,605,840	13,917	306,381,000	191,043,000	371,890,000

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[Appendix C 3.]

TRAFFIC OF THE NEW YORK-PHILADELPHIA CANAL.

[Report of the Committee on Traffic of the proposed Intracoastal Canal connecting New York and Delaware Bays.]

The committee on the traffic of the proposed intracoastal canal connecting New York and Delaware Bays, appointed in November, 1910, by the president of the Atlantic Deeper Waterways Association at the request of a citizens' committee of sixty, consisting of men from New York, New Jersey, Pennsylvania, and Delaware, submits the following report:

SCOPE OF INQUIRY AND SOURCES OF INFORMATION.

A detailed investigation of the available statistical and other sources of information has been made by the committee, with the aid of expert assistance. Ten thousand circular letters were sent out, chiefly to manufacturers and shippers along the Atlantic seaboard, asking what use they would make of the proposed canal and how it would affect their business. Interviews were had with coastwise carriers (steam, sail, and barge), the traffic officers of the Pennsylvania Railroad and the Philadelphia & Reading Railway, and with many individuals having knowledge that might be of assistance to the committee.

The Board of Trade of Newark, N. J., and the Chambers of Commerce in Trenton, N. J., and Richmond, Va., sent the committee valuable special reports upon the probable commercial influence of the proposed waterway.

The following sections of this report present in detail the statistics of the commerce and the industrial activities that would be directly and indirectly served by the Philadelphia-New York link of the chain of intracoastal waterway. The tables of statistics herewith presented are compiled from numerous sources, but mainly from (1) the report made by the United States Bureau of the Census in 1906 upon "Transportation by water," (2) the statistics on coastwise traffic contained in the 1906 and 1909 reports of the Corps of Engineers of the United States Army, (3) the latest annual reports of the United States Department of Agriculture, (4) of the United States Geological Survey, (5) of the United States Commissioner of Navigation, and (6) of the Interstate Commerce Commission.

Attention may also be given to the report upon "Transportation by water," issued by the United States Bureau of Corporations in 1910.

VOLUME AND VALUE OF TRAFFIC WITHIN THE SECTION AFFECTED BY THE PROPOSED CANAL.

According to the report of the Bureau of the Census the cargo tonnage handled coastwise within the district between the ports of Bangor, Me., and Newbern, N. C., amounted to 76,000,000 tons in 1906. The reports compiled by the United States Army Engineers for 1909 make the total coastwise traffic within the same territory 143,000,000 tons. Which of these totals is more nearly correct the committee has no means of knowing. The census figures, while much smaller than those compiled by the Army engineers, show a large volume of coastwise traffic along the Atlantic seaboard.

The total rail traffic (including traffic received from connecting roads) in the New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, North Carolina, and South Carolina, amounted in 1909 to 574,000,000 tons; and of this approximately 325,000,000 tons originated along the rail lines in these States.

The committee has not been able to ascertain the tonnage of rail traffic moving between New York and Philiadelphia. The figures supplied by the railways were only partial. It is believed that the rail traffic between the North Atlantic ports is less than the tonnage, moving by water between these points.

The annual reports of the Pennsylvania Railroad and the Philadelphia & Reading Railway show a total rail tonnage in 1909 for the entire New Jersey division of the

former railroad and for the Central Railroad of New Jersey of approximately 54,000,000 tons; but of this only a relatively small share moves between the ports of New York and Philadelphia. The major portion moves between interior points, and between interior points and the ports of New York and Philadelphia.

The district to be affected by the proposed waterway is one of great industrial importance. According to the census of 1905, the manufacturing districts of the seaboard States from Maine to North Carolina, inclusive, annually use raw materials valued at $4,332,000,000 and have an output valued at $7,671,000,000. At the leading ports from Bangor, Me., to Newbern, N. C., inclusive, raw materials to the amount of $1,824,084,000 are annually used by the manufacturing industries and a finished product amounting to $3,306,911,000 is produced. According to the United States Geological Survey, a mineral production valued at $591,000,000 was produced in 1908 in the seaboard States from Maine to North Carolina, inclusive. The census of 1905 reports an annual lumber output valued at $116,000,000 in these States, and the total for these and the seaboard and Gulf States south of North Carolina, all of which make northern shipments, was valued at $255,000,000. The United States Department of Agriculture reports that the agricultural products within the seaboard States from Maine to North Carolina, inclusive, amounted in 1909 to $688,000,000, and this does not include truck farming and dairy products, which are items of rapidly increasing value within this territory.

DECLINING USE OF SAILING VESSELS AND THE INCREASING USE OF BARGES IN COASTWISE COMMERCE.

The use of sailing vessels in the coastwise traffic of the United States is steadily and rapidly declining. The total tonnage of shipping on the Atlantic and Gulf coasts increased from 2,650,000 tons in 1889 to 4,850,000 tons in 1906; but the gain was in steamships and barges or unrigged craft operated principally by transportation companies, which in turn are largely owned by railroad lines, while the tonnage of independent sailing vessels available for all kinds of commerce decreased during the same period 160,287 tons. The storms of every winter levy their toll upon sailing vessel tonnage, and the loss is not made up.

The sailing fleet is being replaced for the most part, as the needs of established lines require, by steamers and steam-towed barges. The Bureau of the Census reported in 1906 a total tonnage of unrigged craft on the Atlantic and Gulf coasts of 2,260,000, which tonnage exceeded that of freight and passenger steamships by 1,214,811, and was 1,154,721 tons greater than the sailing tonnage. The unrigged craft comprised 46½ per cent of the total tonnage employed on the Atlantic and Gulf seaboards.

The reasons accounting for the substitution of barges for sailing vessels are indicated by the experience of one company transporting coal between Philadelphia and New England ports. The sailing vessels formerly used by this company in this service had an average capacity of 1,200 tons burden, and the fleet employed could deliver, by making 500 voyages, about 600,000 tons per annum. The barges now employed have a capacity of 1,600 to 3,000 tons each and are operated in tows. By making 300 voyages and by dispatching 1,150 barge loads, the company is now able to transport 2,400,000 tons per annum.

Barges are equally well adapted to the lumber traffic, and it is probable that they will be used in the future for the transportation of the greater part of bulky coastwise freight. Barges have certain advantages over sailing vessels as carriers of bulk cargo and for some kinds of traffic over steamships, because of their smaller initial cost of construction, the more continuous and effective use that may be made of their motive power, and of their movement in fleets, with a consequent reduction in the number of crew required to operate the craft. Barges will have a further advantage over sailing vessels in case a large-capacity intracoastal canal is opened, because the barges can be operated through such a waterway with the regularity of steamship traffic.

FREIGHT RATES BY THE PROPOSED CANAL.

The evidence prepared for the committee indicates that the proposed waterway would result in a large saving in freight rates. Present barge rates—via the outside route north from Philadelphia and the outside and inside routes south therefrom—on bulky freight carried between the ports of the Atlantic and Gulf seaboards are much lower than corresponding railroad rates. The following comparative rail and barge rates are representative and emphasize the marked difference in existing charges. This difference would be still greater in case the proposed canal were constructed, because larger barges could be used for inland traffic, because of the absence of canal tolls, and because of the reduced cost of marine insurance.

Comparative rail and barge rates.

Commodity.	Origin and destination.	Barge rate.[1]	Equivalent railroad rate.	Actual railroad rate.
Lumber	Norfolk to Philadelphia.	$2 per thousand feet.	$3.15 per thousand feet.	$1.80 per 2,000 pounds.
Sand	Philadelphia to New York.	85 cents to $1 per ton.	$1.60 per ton	$1.60 per 2,000 pounds.
Railroad ties	Norfolk to Philadelphia.	11 to 12 cents per tie.	15¾ cents per tie	9 cents per 100 pounds.
Pig iron	do	95 cents to $1 per ton.	$1.95 per ton	$1.95 per 2,240 pounds.
Pulp wood	do	$1.80 per cord	$3.85 per cord	$2.20 per 2,000 pounds.
Fertilizer	Philadelphia to Norfolk.	$1 to $1.25 per ton	$1.60 per ton	$1.60 per 2,000 pounds.
Coke	Philadelphia to Baltimore.	60 cents per ton	$1.20 per ton	$1.20 per 2,000 pounds.
Cinders	Philadelphia to New York.	85 cents to $1 per ton.	$1.90 per ton	$1.90 per 2,000 pounds.
Clay	do	do	$1.85 per ton	$1.85 per ton.
Coal anthracite[2]	Philadelphia to Boston	65 to 75 cents per ton.	$2.65 per ton	$2.65 per ton.
Do.[2]	Philadelphia to Providence.	55 to 60 cents per ton.	$2.70 per ton	$2.70 per ton.

[1] Barge rates between Philadelphia and eastern points via outside route; between Philadelphia and southern points via inside route.
[2] Railroad coal rate from Shamokin, Schuylkill district.

It is estimated that a 1,000-ton barge, loading 75 per cent capacity cargo (750 tons), can be profitably operated through the proposed free ship waterway across the State of New Jersey between Philadelphia and New York at an average rate of freight of 45 cents per ton of 2,000 bounds. (See Exhibit A, Appendix C.)

In like manner, a 2,000-ton barge, loading 60 per cent capacity cargo (1,200 tons), could be operated at an average freight rate of 35 cents per ton of 2,000 pounds. (See Exhibit B, Appendix C.)

Terminal charges are not embraced in the above freight rates.

It is estimated that availing of the most modern, comprehensive, up-to-date loading and discharging facilities, 25 cents per ton of 2,000 pounds would cover the handling of cargo into and out of barges, divided 10 cents per ton for loading and 15 cents per ton for discharging. This would make the total transportation charges payable by the shipper 60 to 70 cents per ton.

Barges operated as above, it is estimated, would net their owners respectively 23.2 per cent and 20.8 per cent per annum upon the capital invested.

The principal saving to the shipper using the proposed canal would be on freight which can be delivered direct at industrial wharves or which, if shipped by rail, would require cartage. In the former case the cartage charge is eliminated, and in the latter it would be no less than on freight hauled to and from the water front. At present barge rates and cartage charges, barge transportation, in most instances, affords little if any saving to the shippers who have private rail sidings. However, it is estimated that barge rates through the proposed canal will be lower than existing rates by water. There is a large amount of freight at the present time that is not handled over private railway sidings, as is shown by the large cartage business at the ports and much that is handled to and from industrial wharves.

PROBABLE TRAFFIC THROUGH THE PROPOSED CANAL.

The traffic using the proposed canal will consist largely of coal, lumber of all kinds, building materials, iron and steel, petroleum, pottery, textiles, leather, tobacco, hardware, machinery, fertilizers, cotton, phosphate, naval stores, fruit, vegetables and other farm and garden products, and general merchandise or package freight.

A careful study of the existing sources of traffic indicates that there would be shipped per annum through the canal, during the early years of its operation, at least—

	Tons.
Freight other than coal and lumber	1,250,000
Coal	3,400,000
Lumber	550,000
Total	5,200,000

This is probably an unduly conservative estimate. The tonnage assumed for coal is only 20 per cent of the shipments by water in 1910 from the ports Norfolk to Philadelphia, inclusive. The lumber tonnage taken is 50 per cent of the receipts by water of southern pine at New York and Boston. No allowance is made for southern lumber that will be shipped through the proposed canal to cities between Trenton and New York.

The use made of any canal will depend upon the existence of adequate terminal facilities. Fortunately, the harbor facilities now existing or provided for by plans under consideration by the cities of New York, Newark, Trenton, and Philadelphia indicate that the canal will not be hampered by inadequate arrangements for receiving, handling, and discharging cargo at the ports.

PROBABLE EFFECTS OF THE PROPOSED CANAL UPON RAILWAY AND COASTWISE TRAFFIC AND UPON INDUSTRIAL DEVELOPMENT.

While the cost of transportation through the proposed canal and the rates charged those who ship by that waterway will be considerably less than present railway freight rates, it is not probable that the canal will seriously interfere with the traffic or the profits of the railways. The canal will undoubtedly develop new traffic as the result of the industrial development of the territory served, and also as a medium for reaching distant points, and the consequences will be favorable to the railroads as well as to the shipping and commercial interests within the zone of the canal's influence. The addition of a waterway to existing railway facilities seldom if ever decreases the total traffic handled by the railroads; instead, as experience has shown, it tends to create traffic for the railroads, and particularly traffic in those classes of goods from which the railroads derive the highest freight-rate profits.

It is the opinion of the committee that a canal connecting Delaware and New York Bays and capable of accommodating barges of 1,000 to 3,000 tons burden would be actively used by companies now operating barges by the outside route between Philadelphia and New England points. An ideal route for such barges between Chesapeake Bay and Boston would be afforded by an enlarged Chesapeake & Delaware Canal, the proposed waterway between the Delaware and New York Bays, and canals connecting Long Island Sound with the port of Boston. An inside waterway between North Carolina and New England would increase the volume of coastwise commerce, and, what is hardly less important, would minimize the losses of property and human lives caused by shipwrecks. This safe inside route would be used by a type of craft that can be operated with economy and with certain profit to the owners. One of the strongest arguments in favor of an inside route is the fact that in the single decade from 1900 to 1909 there were over 5,700 disasters to shipping on our Atlantic seaboard. Not all losses are reported, but these accidents are known to have destroyed $40,500,000 worth of vessels and cargo and to have caused the loss of over 2,200 human lives.

In the following sections of this report a careful analysis is made of the industrial effects that would be produced by the construction of the proposed canal. The development resulting from this waterway will be similar to that which followed the opening of the Erie Canal at the beginning of the second quarter of the last century. It is believed by the people of New York State that the enlargement of the Erie and Champlain Canals will again cause those waterways to enhance the industrial progress of the Empire State. The industrial influence actually exerted during the last two or three decades by the Finow Canal and the canalized River Main in Germany are illustrated by two maps, which accompany this report. These maps show that there has been a large development of manufacturing industries along those waterways, neither one of which possesses an industrial location comparable with that of the proposed waterway between Philadelphia and New York.

GENERAL CONCLUSIONS.

The type of canal that should be constructed and the depth and width that should be given the waterway are questions to be largely determined by the Engineer Corps of the United States Army with reference to the requirements of commerce and of the Navy. A sea-level canal would be preferable to one with locks, and the dimensions of the waterway should be at least as great as those of the enlarged Erie and Champlain Canals. For both commercial and naval reasons, greater dimensions would probably be advisable.

The Army engineers estimate that the cost of a sea-level canal between New York and Philadelphia, with a bottom width of 125 feet and a depth of 18 feet, will be $35,250,000. This is less than the value of the property lost along the Atlantic seaboard by shipwrecks during the last 10 years. This annual toll of lives and property

still continues to be levied. Within a few months past three barges, laden with coal and 17 men, were lost in a storm off the coast of Massachusetts.

A canal connecting the New York and Delaware Bays is a most important part of the Atlantic coastal waterway. The Philadelphia-New York Canal will undoubtedly benefit the eastern part of the United States. The project merits the support of the National Government and of the States and municipalities most directly interested.

EMORY R. JOHNSON, *Chairman.*
WILFRED H. SCHOFF, *Secretary.*
GEORGE F. SPROULE.
N. B. KELLY.
FRANK L. NEALL.
E. R. SHARWOOD.
H. F. STETSER.
J. HAMPTON MOORE, *ex officio.*

I. Approximate Amount of Water Traffic of North Atlantic Seaboard.

It is impossible to state precisely the volume of coastwise trade between ports adjacent to the proposed canal, because coastwise vessels are not required to enter and clear at the customhouse or to report their cargo tonnage. The available figures, however, show that the coastwise shipments of the North Atlantic are of large volume. The United States Census of 1906 shows that the total shipments from the leading ports, extending from Bangor, Me., to Newbern, N. C., aggregated 33,263,000 tons of freight. The total receipts at the same ports amounted to 42,704,000 tons. The commodities specified by the census are coal, cement, brick and lime, lumber, stone, sand and gravel, petroleum and other oils, fruits and vegetables, ice, phosphate and fertilizers, pig iron and steel rails, grain, naval stores, canned goods, flour, cotton, iron ore, tobacco, and general merchandise. The shipments and receipts at each of 23 adjacent ports are shown in the accompanying table. (Table I.)

TABLE I.—*Receipts and shipments of leading ports adjacent to the proposed canal.*

[Bureau of the Census, 1906.]

Ports.	Shipments.	Receipts.	Total.
	Net tons.	*Net tons.*	*Net tons.*
New York	8,598,374	17,507,906	26,106,280
Philadelphia	5,213,485	2,721,456	7,934,941
Baltimore	3,579,407	1,858,443	5,437,850
Boston	887,001	6,533,573	7,420,574
Norfolk and Newport News	7,680,230	2,808,346	10,488,576
Providence	341,524	2,749,511	3,091,035
New Haven	161,666	2,156,814	2,318,480
Fall River	274,646	786,392	1,061,038
Washington	92,910	599,177	692,087
Portsmouth	25,390	362,820	388,210
Wilmington, Del	95,241	250,188	345,429
Jersey City	186,982	167,548	354,530
New Bedford	163,951	581,176	745,127
Hoboken	552,348	43,774	596,122
Newark	5,318	315,681	320,999
Perth Amboy	1,463,185	398,883	1,862,068
South Amboy	2,845,014	3,950	2,848,964
New London	240,305	887,404	1,127,709
Bangor	255,613	319,546	575,159
Portland	303,295	1,357,316	1,660,611
Rockland	175,904	149,496	325,400
Wilmington, N. C	121,930	145,209	267,139
Total	33,263,719	42,704,609	75,968,328

TABLE II.—*Total receipts and shipments of domestic commerce as reported by United States Engineers.*

Ports.	1909	1906
	Tons.	*Tons.*
Anacostia River	450,213	335,000
Arthur Kill	9,504,090	16,574,840
Baltimore	[1] 8,415,220	8,277,098
Beverly	196,203	138,862
Boston Harbor	[2] 24,478,668	18,549,230
Beaufort	52,396	10,465
Bridgeport	1,117,131	951,244
Cape Charles City, Va	2,355,984	1,723,635
Connecticut River (below Hartford)	614,780	440,024
Elizabeth River, Va	1,861,402	4,225,179
Greenwich Harbor	79,727	108,348
Gloucester	218,165	275,888
Havre de Grace	(3)	73,815
Housatonic River	81,485	54,496
Hyannis	8,832	20,100
Lynn	359,195	343,784
Mispillion River, Del	187,356	258,704
Nansemond River, Va	96,251	91,063
Nantucket	28,550	20,100
New Bedford	1,392,802	899,632
New Haven	2,019,198	1,847,633
Newburyport	212,029	169,975
New London	707,768	697,139
Newport News	7,268,585	5,564,086
Newport Harbor	239,923	1,920,380
Newtown Creek	5,113,628	2,803,380
New York	[4] 25,509,733	16,921,976
Norfolk	10,972,999	15,600,000
Norwalk Harbor	222,787	251,759
Passaic River	2,650,809	2,577,188
Pawtucket River	475,255	287,739
Philadelphia	19,402,199	20,577,117
Portland, Me	2,956,011	2,546,625
Providence	3,814,982	3,086,003
Raritan Bay	5,333,676	6,432,245
Rappahannock River	397,210	364,000
Richmond and James River Point	476,465	527,818
Roanoke River, N. C	68,113	88,508
Sakonnet Harbor	7,385	(5)
Stamford Harbor	264,615	249,175
St. Jones River, Del	113,550	55,196
Smyrna River	203,580	207,021
Taunton River	126,509	193,100
Thames River	497,725	427,503
Woods Hole, Mass	43,032	27,875
Washington	1,430,788	907,000
Wilmington, Del	805,447	1,016,696
Wilmington, N. C	872,426	814,291
Total	143,704,877	139,532,935

[1] Baltimore: Vessel tonnage.
[2] Boston: Vessel tonnage. Cargo tonnage data not given.
[3] Asked for but not obtained.
[4] New York figures include only outlying bays and rivers, omitting Hudson and East Rivers, where most of the traffic is located. The items included are not the same for 1906 and 1909 and neither total can be compared with that given by the Census.
[5] Not available.

The census statistics of coastwise cargoes are in some respects too low and do not include a sufficient number of ports. For these reasons Table II was compiled from the returns of the United States War Department, for ports extending from Bangor to Newbern. It indicates an approximate total at 48 points for the year 1909 of 143,000,000 tons, and in 1906, the census year, of 139,000,000 tons. These aggregates comprise both shipments and receipts. The reports of the Engineer Corps include only those waterways for the improvement of which appropriations have been made by Congress. They include, however, numerous places not counted as ports in the census and the basis of tabulation is not the same; so that the two totals can not strictly be compared.

Coastwise shipments of coal and lumber are further indicated in the reports of the United States Bureau of Statistics. From the following table (Table III) it is seen that in 1910 approximately 17,290,147 tons of anthracite and 26,121,224 tons of bituminous coal, a total of 43,411,371 tons were shipped by water from the five leading ports—New York, Philadelphia, Baltimore, Norfolk, and Newport News. These figures include coal for the use of vessels in the domestic trade, and therefore differ widely

from those of the Bureau of the Census. Shipments from New York include those from adjacent ports on New York Bay. New England ports are particularly heavy receivers of this coal, the Boston Chamber of Commerce reporting that in 1909 Boston alone received 1,668,126 tons of anthracite and 3,393,423 tons of bituminous coal by sea. The United States Bureau of Corporations estimated that New England ports received 16,752,053 tons of coal by water in 1905, and 14,236,920 tons in 1906.

TABLE III.—*Shipments of coal by water.*

Port.	Anthracite.	Bituminous.	Total.
New York	15,036,622	11,289,095	26,325,717
Philadelphia	1,980,830	4,700,174	6,681,004
Baltimore	272,695	3,780,120	4,052,815
Norfolk		3,534,134	3,534,134
Newport News		2,817,120	2,817,701
Total	17,290,147	26,121,224	43,411,371

The 4,256,000 tons of lumber which the Bureau of the Census reports as having been shipped from and received at ports tributary to the proposed canal may be supplemented with the data of the Bureau of Statistics. This bureau reports that in 1909, 133,146,700 feet of southern lumber were received at Boston by water, and 486,660,800 feet of southern pine at New York. It reports that 68,186,000 feet of pine were shipped from the ports of Virginia and the Carolinas immediately south of the proposed canal; and in 1907 these shipments aggregated 128,957,900 feet. The Board of Commissioners of Navigation report the annual coastwise lumber receipts of Philadelphia at 226,717,318 feet, and the Lumbermen's Exchange presents an even larger figure.

The Board of Commissioners of Navigation prepared for the use of the committee an itemized statement of the tonnage of the port of Philadelphia for the year ending December 31, 1910. These statistics do not permit the computation of a total, but are of interest in that they indicate particular items. The following table (Table IV) shows the principal cargoes landed by vessels other than regular-line steamers.

TABLE IV.

Items.	Receipts via Delaware and Raritan and Chesapeake and Delaware Canals.		Receipts via Delaware Capes.		Total (equivalent in tons).
	Amount.	Equivalent in tons.	Amount.	Equivalent in tons.	
Lumber ... feet	121,005,483	211,758	105,781,835	184,996	396,754
Railroad ties	885,354	64,151	1,701,861	127,639	191,790
Sand ... tons	10,401	10,401	(1)		10,401
Bricks	460,000	1,035	460,000	1,035	2,070
Pig iron ... tons	49,099	49,099	(1)		49,099
Mine props ... do	60,555	60,555	(1)		60,555
Salt ... bushels	49,000	1,715	(1)		1,715
Pulpwood ... cords	19,752	34,566	(1)		34,566
Cinders ... tons	10,055	10,055	3,697	3,697	13.752
Oak staves	50,000	89	(1)		89
Piling ... tons	1,075	1,075	(1)		1,075
Chestnut poles	52,000		(1)		(2)
Logs	2,416		(1)		(2)
Scrap iron ... tons	1,300	1,300	4,800	4,800	6,100
Wood blocks ... do	1,150	1,150	(1)		1,150
Phosphate rock ... do	563	563	14,219	14,219	14,782
Shingles			3,600,000	1,620	1,620
Oil ... bbls			3,099,981	619,996	619,996
Stone ... tons			21,350	21,350	21,350
Asphaltum ... bbls			20,700	3,105	3,105
Coal tar ... do			38,000	5,700	5,700
Sulphur ... tons			5,800	5,800	5,800
Plaster ... do			5,825	5,825	5,825
Feldspar			3,080	3,080	3,080

[1] Amounts not stated. [2] Weight not known.

The coastwise tonnage, receipts, and shipments of Philadelphia in regular line steamers are estimated as shown in Table V.

TABLE V.—*Water traffic tonnage, estimated.*

PORT OF PHILADELPHIA.

	Tons.
Norfolk	200,000
Savannah	400,000
Boston	450,000
Providence and Fall River	200,000
Baltimore, via canal	400,000
New York and outside route	750,000
Charleston and Jacksonville	150,000
Tampa	50,000
New Orleans	70,000
Total	2,675,000

WITHIN THE DELAWARE CAPES.

Upper Delaware	100,000
Wilmington, Wilson Line	70,000
Bush Line	70,000
Chester Freight Line	100,000
Salem & Philadelphia Navigation Co	15,000
City of Salem	40,000
Smyrna	12,000
Roeblings	50,000
Van Sciver	20,000
Odessa	10,000
Lebanon	10,000
Atlantic City	10,000
Milford	10,000
Frederica	10,000
Pennsgrove	20,000
Total	547,000
Grand total	3,222,000

TABLE VI.—*Coal shipments of Philadelphia to coastwise ports, 1909 and 1910.*

The coal shipments of Philadelphia to coastwise ports in 1909 and 1910 are stated by the Board of Commissioners of Navigation as follows:

Items (per ton).	Coastwise ports.		Within Delaware Capes.		Total.	
	1910	1909	1910	1909	1910	1909
Total anthracite	1,192,163	1,292,667	513,875	473,749	1,706,038	1,766,416
Total bituminous	1,661,369	1,638,201	966,144	1,889,010	2,627,513	3,527,211
Grand total	2,853,532	2,930,868	1,480,019	2,362,759	4,333,558	5,293,627

It is also reported that in 1910, 362,196,361 gallons of oil were shipped from Point Breeze and Marcus Hook.

The amount of coastwise traffic is further indicated by the number and tonnage of the vessels in which it is carried.

TABLE VII.—*All vessels and craft of the Atlantic and Gulf coasts, 1906.*

Class.	Number of vessels.	Gross tonnage.	Value of vessels.
Freight and passenger (steam)	1,523	1,045,811	$121,136,485
Freight and passenger (sail) [1]	4,227	1,105,901	33,213,849
Unrigged craft	8,699	2,260,622	41,658,685
Tugs and towing vessels	1,690	148,992	25,894,551
Ferryboats	270	162,834	19,970,466
Yachts (steam)	1,577	70,461	21,290,339
Yachts (sail)	1,358	21,046	3,775,743
All other	888	35,754	6,165,797
Total [1]	20,032	4,851,421	273,105,915
Schooner barges	389	323,618	7,497,833

[1] Including schooner barges.

Table VII, compiled from the report of the Bureau of the Census, shows that in 1906 there were 20,032 vessels, documented and undocumented, with a gross tonnage of 4,851,421 tons, engaged in carrying freight and passengers to and from the ports of the Altantic and Gulf coasts. The capital invested in them aggregated over $273,000,000. As compared with the vessel situation of 1889, as shown by the Bureau of the Census, the number of vessels increased from 12,238, or 63.7 per cent, gross tonnage from 2,658,455, or 82.5 per cent, and the value of the vessels from $116,042,062, or 135.4 per cent.

The documented tonnage engaged in the trade of the Atlantic and Gulf coasts is annually reported by the United States Commissioner of Navigation. Table VIII, compiled from this report, shows a total of 17,203 vessels with a gross tonnage of 3,500,394 tons, and an increase of 95 per cent in the tonnage since 1889.

TABLE VIII.—*Enrolled and licensed vessels, over 20 tons, of Atlantic and Gulf coasts.*

Year.	Total.		Sail.[1]		Steam.	
	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.
1909	17,203	3,500,394	11,108	1,841,101	6,095	1,659,293
1905	16,763	2,763,866	12,500	1,670,105	4,263	1,093,761
1900	15,742	2,190,552	12,516	1,323,958	3,226	866,594
1895	16,247	2,033,367	13,190	1,240,148	3,057	793,219
1890	16,214	1,917,041	13,504	1,226,208	2,710	690,833
1889	16,261	1,786,065	13,522	1,112,649	2,739	673,416

[1] Including barges and canal boats.

The reports of the Commissioner of Navigation further show that 15,966 vessels were, in 1909, documented at the ports adjacent to the proposed canal; 7,132 of these vessels were sailing vessels, 5,679 steam vessels, and 3,155 barges and canal boats, and their aggregate gross tonnage was 3,862,000 tons.

TABLE IX.—*Documented*[1] *vessels of ports adjacent to proposed canal (1909).*

Ports of—	Sailing vessels.		Steam vessels.		Canal boats.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
Maine	1,007	201,539	459	66,555	12	5,389	1,478	273,483
New Hampshire	12	1,648	9	588	13	1,341	34	3,577
Vermont	5	353	8	2,901	7	716	20	3,970
Massachusetts	750	215,996	503	116,394	23	8,161	1,276	340,551
Rhode Island	64	9,037	217	13,933	7	1,602	288	24,572
Connecticut	253	55,557	347	84,885	151	45,154	751	185,596
New York	1,033	278,846	2,299	1,326,328	3,294	529,777	1,726	2,134,951
Pennsylvania	217	127,779	518	197,712	167	64,574	902	390,065
New Jersey	646	59,057	288	25,361	205	55,389	1,139	139,807
Delaware	95	13,282	50	20,678	14	4,955	159	38,915
Maryland	1,441	72,906	303	123,570	111	28,670	1,855	225,146
District of Columbia	22	2,170	39	14,795			61	16,965
Virginia	1,115	28,211	394	26,762	34	13,690	1,543	68,663
North Carolina	472	7,248	245	7,576	17	1,091	734	15,915
Total	7,132	1,073,629	9,679	2,028,038	3,155	760,509	15,966	3,862,176

[1] Including registered tonnage.

It is not feasible to tabulate the detailed vessel data for all ports of the North Atlantic, but those of New York and Philadelphia may be analyzed to show the nature of the vessels engaged in the coastwise trade. Table X shows that at the end of the fiscal year 1910 the enrolled and licensed fleet of the port of New York comprised 3,536 vessels with a gross tonnage of 1,266,246 tons, distributed among the various classes of vessels as follows:

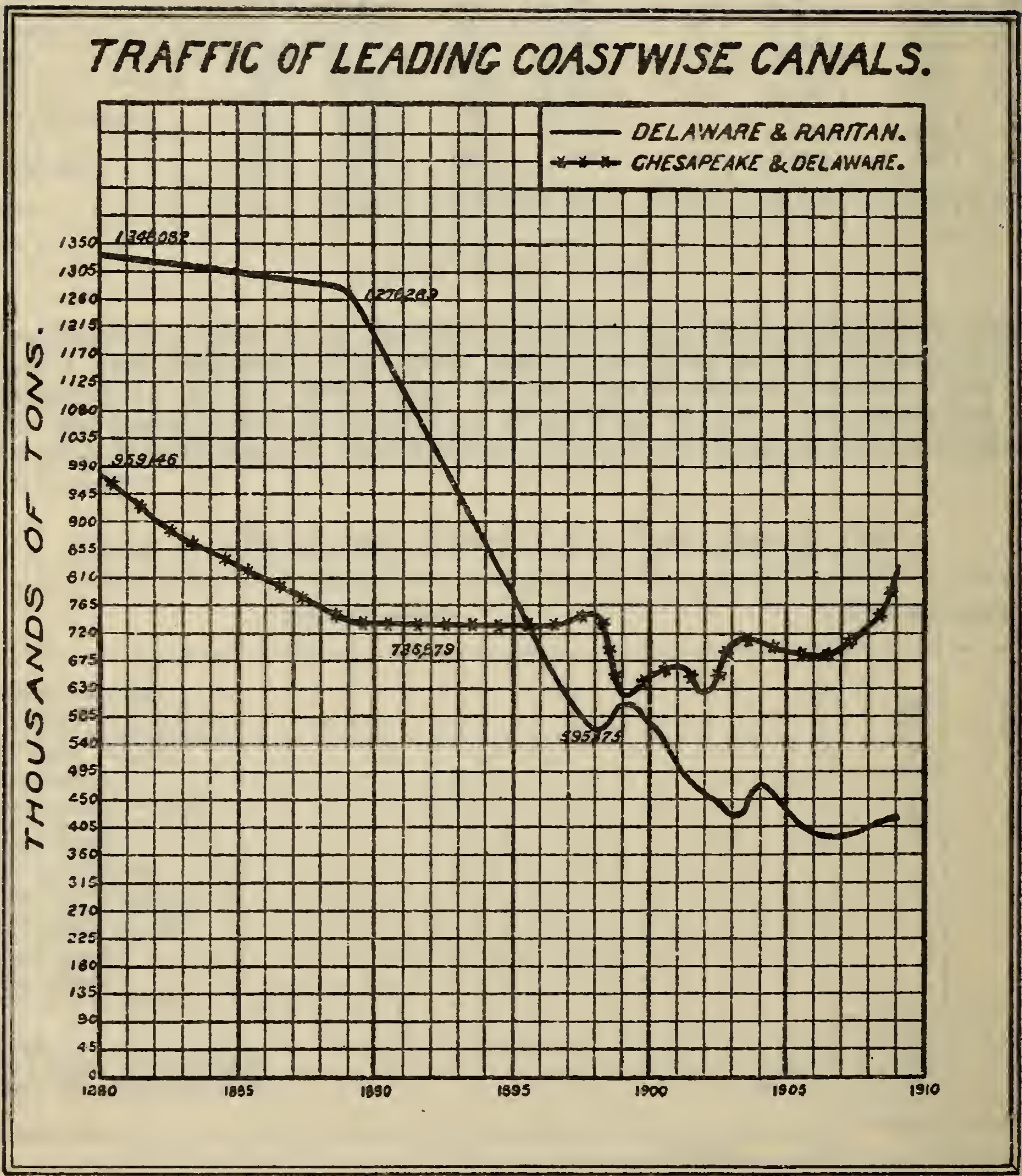
TABLE X.—*Documented tonnage at New York (June 30, 1910).*

Enrolled vessels.	Number.	Gross tons.
Permanently enrolled:		
Sailing vessels (wood)	389	180,189
Steam vessels (wood)	647	122,140
Canal boats (wood)	44	6,558
Barges (wood)	1,499	411,910
Sailing vessels (metal)	21	32,985
Steam vessels (metal)	362	422,061
Barges (metal)	32	15,874
Temporarily enrolled:		
Sailing vessels (wood)	25	14,142
Steam vessels (wood)	6	649
Canal boats (wood)	1	113
Barges (wood)	9	2,524
Barges (steel)	3	936
Steam vessels (metal)	9	28,888
Total	3,047	1,258,969
Licensed vessels, under 20 tons	489	7,277
Registered vessels (foreign trade)	107	336,789
Grand total[1]	3,643	1,603,035

[1] Excluding yachts and house boats.

The entire fleet comprises 536 sailing vessels with a gross tonnage of 246,270 tons; 1,500 steam vessels, gross tonnage, 915,516; 45 canal boats, gross tonnage, 6,671; and 1,562 barges with a gross tonnage of 434,578 tons. All but 81 of the sailing vessels have a gross tonnage of less than 1,000 tons each, and all but 5 less than 2,500 tons. All but 220 of the steam vessels have a gross tonnage of less than 1,000 tons each, and all but 121 are of less than 2,500 tons. Barges are not specified as to their size, but their average gross tonnage is 278 tons. It appears that the great majority of even the steam and sailing vessels documented at New York are not excluded from the proposed canal by their dimensions.

The itemized account of the fleet documented at Philadelphia is shown in Table XI.



THE NORRIS PETERS CO., WASHINGTON, D. C

House Doc. No. 391 ; 62d Cong., 2d Sess.

TABLE XI.—*Documented tonnage of Philadelphia (June 30, 1910).*

Enrolled vessels.	Number.	Gross tons.
Permanently enrolled:		
Sailing vessels (wood)	148	100,973
Steam vessels (wood)	89	11,659
Barges (wood)	148	53,848
Sailing vessels (metal)	6	4,788
Steam vessels (metal)	115	63,456
Barges (metal)	11	9,090
Temporarily enrolled:		
Sailing vessels (wood)	9	5,306
Steam vessels (wood)	1	83
Barges (wood)	4	967
Barges (metal)	2	561
Sailing vessels (metal)	1	2,128
Steam vessels (metal)	2	4,001
Total	536	256,860
Licensed vessels	104	2,001
Registered vessels (foreign trade)	15	28,093
Grand total [1]	655	286,954

[1] Excluding yachts.

The fleet consists of 198 sailing vessels of 116,956 gross tonnage, 286 steam vessels of 104,313 tons, and 171 barges of 65,685 tons. The entire coastwise fleet comprises 640 vessels with a gross tonnage of 258,861 tons. All but 18 of the entire sailing fleet and all but 20 of the steam fleet have a gross tonnage of less than 1,000 tons each. None of the sailing vessels and but 6 of the steamers have a gross tonnage of 2,500 tons or over, and the average tonnage of the barge fleet is 384 tons.

It should be noted that the foregoing figures do not include undocumented tonnage. At the port of New York are many thousand lighters and floats used for harbor work. These craft are not enrolled. They would not be much used for canal traffic except to and from points located upon the canal near its termini; hence they need not be considered in this analysis.

The large coastwise traffic of the North Atlantic is at present dependent but slightly upon canals. The following chart graphically shows the decline in tonnage of the Delaware & Raritan from 1,348,000 tons in 1880 to 401,231 in 1909, and of the Chesapeake & Delaware from 959,146 tons in 1880 to 818,386 in 1909. Yet it is significant that in spite of the inadequate dimensions of these two canals they still handle 1,219,617 tons of freight annually. The traffic of the Delaware & Raritan consists mainly of coal, sand, brick, and stone, iron, lumber, clay, oil, coke, and general merchandise, and that of the Chesapeake & Delaware chiefly of lumber, coal, sand and stone, railroad ties, iron, fertilizers, and general merchandise. Though these waterways do not indicate the amount of freight which would pass through a large and improved canal, they show that certain quantities of bulky freight will seek even an inadequate inland waterway in preference to the more dangerous open-sea route or the more expensive railroad transportation.

II. Railroad Traffic Between Points Adjacent to the Proposed Waterway.

The rail carriers do not at present report their tonnage statistics in such a way as to show the movement between given points, and thus the rail traffic moving between places on the north and middle Atlantic coast can not be accurately stated. The data of the Interstate Commerce Commission are classified by groups or divisions of territory. Group I includes New England; Group II, New York, Pennsylvania, Delaware, and New Jersey; and Group IV, Virginia, West Virginia, North and South Carolina. Within these three districts the railways in 1909 carried 573,902,548 tons, including freight received from connecting lines. The tonnage originating within these districts is not separately stated. For the entire country, however, the originated tonnage is 56.6 per cent of the total, including freight received from connecting lines; and, at this rate, it would be approximately 324,828,000 tons in the coast States from South Carolina to Maine.

The annual report of the Pennsylvania Railroad for 1909, furthermore, states the total freight tonnage of the New Jersey division as 34,199,226 tons. The annual report of the Philadelphia & Reading does not separate the tonnage of the Central Railroad of New Jersey from that of the entire system, but the Interstate Commerce Commission

reports its freight revenue for 1909 at $16,588,966. The average receipts per ton of freight in Group II are $0.842, and at that rate the freight tonnage of the Central Railroad of New Jersey is approximately 19,702,000 tons. The annual tonnage of the two railways operating in the territory of the proposed waterway is, therefore, approximately 53,901,000 tons.

The greatest portion of this traffic, however, moves to and from the ports and points in the interior, and between interior points, and not between coastwise points. As is shown in the table on next page, the largest items in the traffic of the New Jersey division of the Pennsylvania Railroad are coal, lumber, stone and sand, cement, brick, and lime, bar and sheet metal, castings and machinery, fruits and vegetables, pig and bloom iron and coke. The bulk of this traffic goes to the coastwise points direct from the interior or is shipped to certain ports by rail and is there transshipped by water. Available rail traffic statistics do not, therefore, indicate the rail movement between the ports of the North Atlantic.

The statements furnished to the committee by the Pennsylvania Railroad and the Philadelphia & Reading Railway as to their traffic between Philadelphia and New York City do not lessen the dearth of statistics to any great extent. The data supplied by the Pennsylvania Railroad refer to certain specified articles, and the figures submitted by both railroads include only traffic originating at Philadelphia and New York City. The approximate total traffic reported upon by the two railroads—the classified freight of the Pennsylvania Railroad being estimated—amounts to about 247,000 tons. The special commodities which the Pennsylvania Railroad reported upon are grain, mill products, animal products, lumber, oils, and petroleum products, sugar, castings and machinery, bar and sheet metal, cement, brick, and lime. The Philadelphia & Reading Railway reported its Philadelphia-New York tonnage to consist almost entirely of classified freight.

TABLE XII.—*Classification of freight traffic, New Jersey division, Pennsylvania R. R., excluding Delaware & Raritan Canal.*

	Tons.
Products of agriculture:	
Grain	422,548
Flour	254,916
Other mill products	150,396
Hay	177,985
Tobacco	27,164
Cotton	65,070
Fruits and vegetables	790,456
Other articles	219,530
Products of animals:	
Live stock	248,221
Dressed meats	154,635
Other packing-house products	74,574
Poultry, game, and fish	84,858
Wool	26,187
Hides and leather	132,795
Other articles	118,032
Products of mines:	
Anthracite coal	5,245,714
Bituminous coal	11,891,601
Coke	596,824
Ores	127,366
Stone, sand, and like articles	1,758,989
Other articles	254,248
Products of forests:	
Lumber	2,028,832
Other articles	160,672
Manufactures:	
Petroleums and other oils	346,635
Sugar	214,476
Naval stores	26,258
Iron, pig and bloom	738,925
Iron and steel rails	203,129
Castings and machinery	825,502
Bar and sheet metal	927,616
Cement, brick, and lime	1,156,801

	Tons.
Manufactures—Continued.	
Agricultural implements	23, 466
Wagons, carriages, tools, etc	117, 387
Wines, liquors, and beers	94, 718
Household goods and furniture	39, 306
Other articles	2, 668, 388
Merchandise	416, 305
Miscellaneous	1, 388, 701
Total	34, 199, 226

It is estimated further that 85 per cent of the rail shipments via New York and Philadelphia pass beyond these points to and from southern and New England points. This would bring the total rail shipments between Philadelphia and New York City to approximately 1,632,000 tons. If the rail shipments between New Jersey points and Philadelphia and New York and between New Jersey points reached by the proposed canal amount to two-thirds of the through shipments, or aggregate 1,000,000 tons, the grand total would be 2,632,000 tons.

These figures do not tally with the well-known volume of business. If they were a complete measure of the rail tonnage they would indicate that the two great railroads between the points reached by the proposed waterway handle a smaller traffic than is at present shipped by water.

III. Production in the Territory Adjacent to the Proposed Canal.

The sections adjacent to the proposed waterway comprise the leading manufacturing districts of the United States. While not all of this production, nor even the major share of it, is available for shipment through the canal, the vast manufacturing industries nevertheless constitute one of the large sources of the traffic of the canal. Table XIII, compiled from the reports of the United States Bureau of the Census, shows that in 1905 there were in the aggregate 97,733 manufacturing establishments in the States adjacent to the proposed canal, having a total capitalization of $7,007,153,000, 3,025,000 wage earners, materials valued at $4,332,000,000, and finished products valued at $7,671,000,000.

Table XIII.—*Total manufactures, 1905.*

State.	Establishments.	Capital (thousands).	Wage earners.	Cost of materials used (thousands).	Value of products (thousands).
New Jersey	7,010	$715,060	266,336	$470,449	$774,369
New York	37,194	2,031,460	856,947	1,348,603	2,488,346
Pennsylvania	23,495	1,995,837	763,282	1,142,943	1,955,551
Maine	3,145	143,708	74,958	80,042	144,020
New Hampshire	1,618	109,495	65,366	73,216	123,611
Vermont	1,699	62,659	33,106	32,430	63,084
Massachusetts	10,723	965,949	488,399	626,410	1,124,092
Connecticut	3,477	373,284	181,605	191,302	369,082
Rhode Island	1,617	215,901	97,318	112,872	202,110
Delaware	631	50,926	18,475	24,884	41,160
Maryland	3,852	201,878	94,174	150,024	243,376
North Carolina	3,272	141,001	85,339	79,268	142,521
Total	97,733	7,007,158	3,025,305	4,332,443	7,671,322

To narrow this vast production down to the seaboard districts exclusively, Table XIV was constructed. It shows that in the leading ports from Bangor, Me., to Newbern, N. C., there were 40,196 manufacturing establishments in 1905, with a total capital of $2,667,914,000; 1,151,146 wage earners, materials valued at $1,824,084,000; and finished products valued at $3,306,911,000.

TABLE XIV.—*Total manufactures of leading cities influenced by proposed canal, 1905.*

City.	Establishments.	Capital (thousands).	Wage earners.	Cost of materials (thousands).	Value of products (thousands).
Baltimore	2,163	$148,764	65,224	$81,014	$151,547
Bangor, Me	87	2,944	1,496	1,737	3,408
Bayonne, N. J	58	50,297	7,057	46,984	60,634
Boston	2,747	131,563	59,160	94,603	184,351
Bridgeport, Conn	306	49,381	19,492	22,335	44,587
Camden, N. J	298	31,992	12,661	20,423	33,587
Chester, Pa	131	22,070	7,061	10,422	16,645
Elizabeth, N. J	124	23,564	12,335	16,982	29,301
Fall River	234	69,375	26,836	26,096	43,473
Harrison, N. J	41	11,389	4,040	3,629	8,409
Hoboken	279	11,777	7,227	6,580	14,077
Jersey City	628	82,395	20,353	48,799	75,741
Lynn, Mass	431	23,139	21,540	32,616	55,003
Newark, N. J	1,600	119,026	50,697	80,689	150,055
New Bedford	176	40,410	17,855	16,091	29,469
Newbern, N. C	21	1,233	762	675	1,343
New Brunswick	71	10,393	4,590	4,158	8,917
New Haven	490	31,413	21,437	18,521	39,666
New London	57	4,590	2,554	2,527	4,710
Newport News	25	22,958	7,406	4,479	9,054
New York	20,839	1,042,946	464,716	818,029	1,526,523
Norfolk	123	4,576	3,063	3,261	5,900
Passaic	95	28,611	11,000	13,110	22,783
Perth Amboy	53	11,583	3,950	30,316	34,800
Philadelphia	7,087	520,179	228,899	333.352	591,388
Plymouth	35	7,910	2,300	8,568	11,116
Portland, Me	243	6,280	4,345	4,354	9,133
Portsmouth	27	2,631	638	888	2,602
Richmond	281	31,953	12,883	13,102	28,203
Rockland, Me	50	2,382	949	951	1,823
Salem, Mass	143	9,670	5,945	7,921	12,202
Stamford	62	7,526	3,341	2,330	5,890
Trenton	312	41,623	14,252	17,692	32,720
Washington, D. C	482	20,200	6,299	7,732	18,359
West Hoboken	95	6,018	3,562	3,122	5,947
Wilmington, Del	247	33,227	13,554	18,173	30,390
Wilmington, N. C	55	1,926	1,667	1,823	3,155
Total	40,196	2,667,914	1,151,146	1,824,084	3,306,911

The value of the leading products manufactured in the States adjacent to the proposed canal is shown in Table XV. The iron and steel, glass, foundry, and machine-shop products, electrical machinery, chemicals, cars, and shop construction, boots and shoes, leather, malt liquors, lumber and timber products, petroleum, pottery, terra-cotta and fire-clay products, slaughtering and meat-packing products, textiles, tobacco products, wire, brick and tile, clothing, flour and grist, furniture, sugar and molasses, paper and wood pulp, structural iron, and lime and cement constitute an imposing array of manufactures, many of which are suitable for shipment through the proposed canal.

The region bordering the canal includes five of the greatest industrial districts of the United States—those of New York, Philadelphia, Boston, Baltimore, and Providence. These districts include the main cities and also all others in their immediate vicinity, some of which are not ports and are therefore not included in Table XIV. As reported by the Bureau of the Census in 1905, they are among the 13 leading manufacturing districts in the country, with a total capital of $2,843,748,451, and annual products valued at $3,638,482,807.

TABLE XV.—*Leading manufactures of Atlantic Seaboard States.*

[In thousands of dollars.]

State.	Boots and shoes (leather).	Cars and shop construction.	Chemicals.	Electric machinery.	Foundry and machine-shop products.	Glass.	Iron and steel.
New Jersey	6,977	6,899	13,024	13,803	41,540	6,450	23,667
Pennsylvania	14,608	80,450	15,427	26,258	119,651	27,672	471,228
New York	34,137	22,137	29,090	35,348	115,876	4,029	29,862
Delaware		5,158			3,432		1,597
Maryland	1,011	5,752	1,082	225	9,172	704	12,230
Virginia	2,627	8,693	490		2,768	549	4,859
Connecticut	1,280	2,155		4,940	20,068	738	5,151
Rhode Island	175			5,435	16,339	62	[1] 908
Massachusetts	144,291	6,349	3,509	15,882	58,509	1,333	11,948
Maine	12,351	1,190			4,767		
New Hampshire	22,426	1,600		150	3,082		
Vermont	676	860			3,184		
North Carolina	186	2,444			2,465		
Total	240,745	143,687	62,622	102,041	400,853	41,537	561,450

State.	Leather.	Malt liquors.	Lumber and products.	Flour and grist.	Furniture.	Lime and cement.
New Jersey	21,495	17,466	7,254	5,469	1,404	3,173
Pennsylvania	69,428	34,864	53,571	38,519	12,377	13,502
New York	21,643	61,958	54,090	54,546	28,111	3,766
Delaware	10,251	760	687	1,537		
Maryland	1,911	4,967	6,167	7,318	3,445	447
Virginia	5,830	1,201	17,265	13,832	803	1,317
Connecticut	875	2,927	4,590	1,982	557	296
Rhode Island	349	2,740	1,318	1,134	45	
Massachusetts	33,353	11,081	12,636	4,618	11,093	401
Maine	2,500		20,162	3,932	377	1,174
New Hampshire	1,774	2,255	9,007	2,542	846	
Vermont	342		8,969	3,206	1,533	266
North Carolina	2,662		19,134	6,864	6,182	
Total	172,413	140,199	214,850	145,499	66,773	24,342

State.	Paper and wood pulp.	Structural iron work.	Sugar and molasses refining.	Fertilizers.	Petroleum.	Pottery, terra cotta, and fire clay.	Slaughtering and meat packing.	Smelting and refining copper.
New Jersey	5,043	4,365		5,652	46,609	11,717	17,238	62,795
Pennsylvania	15,411	23,706	37,183	4,095	47,460	10,759	32,321	
New York	37,751	19,657	116,439	2,082		3,289	73,218	5,179
Delaware	1,905			371			548	
Maryland	3,296	842		6,632	(2)	852	6,701	
Virginia	3,034	625		4,659		77	1,996	
Connecticut	5,039	348		943		144		106
Rhode Island		147					2,499	
Massachusetts	32,012	2,692		1,978		718	37,099	
Maine	22,951			66			648	
New Hampshire	8,930							
Vermont	3,831		149					
North Carolina				3,099		106	[3] 192	
Total	139,203	52,382	153,771	29,577	94,069	27,662	172,460	68,080

[1] Not made in rolling mills or steel works.
[2] Baltimore refineries not separately specified.
[3] Not including meat packing.

TABLE XV.—*Leading manufactures of Atlantic Seaboard States*—Continued.

State.	Textiles.	Tobacco manufacturers.	Wire.	Brick and tile.	Clothing.	Grand total by States.
New Jersey	96,060	10,987	11,104	3,796	8,614	452,581
Pennsylvania	188,432	40,897	3,757	7,280	37,748	1,426,604
New York	123,668	65,597	13,039	7,430	340,716	1,302,678
Delaware	....	161	....	205	....	26,612
Maryland	7,317	4,648	250	1,097	22,805	108,871
Virginia	7,842	16,768	....	1,804	954	97,993
Connecticut	56,933	2,350	2,600	921	1,614	116,557
Rhode Island	103,096	358	208	....	....	134,813
Massachusetts	271,370	6,578	5,326	1,171	21,724	695,671
Maine	32,985	450	....	420	1,097	105,071
New Hampshire	47,800	570	43	529	1,040	102,594
Vermont	7,775	127	....	104	1,640	32,662
North Carolina	50,294	28,088	....	696	1,401	123,813
Total	993,572	177,579	36,327	25,453	439,353	4,726,520

TABLE XVI.—*Manufactures of five industrial districts, 1905.*

	Establishments.	Capital.	Wage earners.	Cost of materials.	Value of products.
Industrial district of New York City	25,257	$1,572,628,947	654,988	$1,209,010,634	$2,144,488,093
Philadelphia	7,780	622,081,779	261,456	387,566,027	677,781,117
Boston	4,870	311,088,956	160,481	249,836,524	457,254,360
Baltimore	2,243	166,770,882	71,432	124,600,047	202,659,272
Providence	1,237	171,177,887	73,391	86,568,340	156,299,965
Total of five districts	41,387	2,843,748,451	1,221,748	2,057,581,572	3,638,482,807

Minerals constitute a second basis of traffic. Table XVII, compiled from the reports of the United States Geological Survey, contains an itemized account of the minerals produced in the region bordering on the proposed canal in 1908. They comprise an aggregate value of $591,424,000. Many of them, such as coal, clay products, lime, stone and slate, sand and gravel, glass sand, cement, pig iron, and petroleum are especially adapted to water transportation.

TABLE XVII.—*Value of production of minererals in adjacent States, 1908 (United States Geological Survey).*

[In thousands of dollars.]

State.	Clay products.	Feldspar.	Lime.	Mineral waters.	Slate.	Stone.	Ocher, etc.	Sand and gravel.	Talc and soapstone.	Coal.	Glass.	Cement.	Graphite.	Gypsum.	Pig iron.	Gas.	Petroleum.	Salt.	Other minerals.	Total.
Maine	543	123	661	394	214	2,028	......	......	......	......	......	......	......	......	......	......	......	......	82	4,045
New Hampshire	372	......	......	260	......	867	......	......	......	......	......	......	......	......	......	......	......	......	116	1,615
Vermont	89	......	170	17	1,710	7,153	2	42	100	......	......	......	......	......	......	......	......	......	31	9,314
Massachusetts	1,647	......	566	228	......	2,955	......	90	......	(1)	25	(1)	......	......	......	......	......	......	414	5,925
Rhode Island	......	......	......	39	......	556	......	......	......	......	......	......	(1)	......	......	......	......	......	......	595
Connecticut	......	66	308	36	......	1,126	......	8	......	......	......	......	......	......	......	......	......	......	1,177	2,721
New York	8,929	53	530	878	......	6,157	65	1,349	697	......	4	2,255	116	761	15,879	959	2,072	2,137	2,829	45,670
New Jersey	12,314	......	135	126	......	1,532	......	666	......	......	46	2,416	......	......	3,370	......	......	......	711	21,316
Pennsylvania	14,843	104	1,884	197	3,903	6,371	192	1,719	......	276,995	484	13,987	17	......	111,385	19,105	16,881	......	5,016	473,083
Delaware	147	......	......	......	......	196	......	32	......	......	......	......	......	......	......	......	......	......	8	383
Maryland	1,441	52	293	76	103	968	......	390	......	5,117	14	(1)	......	......	......	......	......	......	3,036	11,490
North Carolina	944	......	25	27	......	800	......	2	51	......	......	......	......	......	......	......	......	......	292	2,141
Virginia	1,499	(1)	424	207	194	602	......	119	458	3,869	......	(1)	(1)	......	4,578	......	......	......	1,176	13,126
Total	42,768	398	4,996	2,485	6,124	31,311	259	4,417	1,306	285,981	573	18,658	133	761	135,212	20,064	18,953	2,137	14,888	591,424

[1] Less than $1,000.

Another classification of minerals, as made by the Bureau of the Census, is shown in Table XVIII. The States adjacent to the proposed canal were, in 1905, credited with 59,910 mines and quarries, employing 240,760 wage earners, using materials valued at $43,073,000, and producing minerals valued at $289,734,000.

TABLE XVIII.—*Summary of mines and quarries in adjacent States (1905), United States Census.*

State.	Number of mines, etc.	Wage earners.	Cost of materials.	Value of product.
Maine	135	3,684	$476,964	$3,656,134
New Hampshire	56	1,253	134,128	1,176,312
Vermont	192	5,398	1,076,143	5,904,705
Massachusetts	251	4,242	762,335	4,671,855
Rhode Island	22	667	85,127	774,611
Connecticut	90	1,497	236,075	1,425,959
New York	9,768	9,560	3,002,554	13,350,421
New Jersey	162	5,645	2,235,964	6,605,402
Pennsylvania	48,672	190,935	33,111,903	236,871,417
Delaware	12	504	45,361	448,467
Maryland	232	6,826	859,755	7,313,712
Virginia	192	8,993	928,387	6,607,807
North Carolina	126	1,556	118,782	927,376
Total	59,910	240,760	43,073,478	289,734,178

The lumber industry comprises a third traffic source. The returns of the Census office, summarized in Table XIX, show that in 1905 there were 6,428 establishments engaged in the lumber industry of the States from Maine to North Carolina, inclusive, employing 77,789 wage earners, and $88,840,000 of capital. Materials valued at $39,738,000 were used annually, and their output was valued at $116,235,000. Much lumber, however, is shipped to North Atlantic ports from the States south of North Carolina. As shown in the table, there were 3,991 additional establishments in the lumber industry of these States, with an annual product valued at $138,508,000. The aggregate lumber output of all the States from which the canal may be expected to draw traffic was, in 1905, valued at $254,743,000.

TABLE XIX.—*Lumber and timber products in adjacent States (1905), United States Census.*

State.	Number of establishments.	Capital.	Wage earners.	Cost of materials.	Value of product.
Maine	752	$15,083,395	12,023	$7,084,131	$17,937,683
New Hampshire	386	6,079,442	4,594	2,817,671	7,519,431
Vermont	418	5,409,750	4,216	2,183,068	5,888,441
Massachusetts	296	3,283,773	1,942	2,428,441	4,903,714
Rhode Island	22	156,141	198	100,177	401,170
Connecticut	114	839,567	1,069	499,802	1,562,254
New York	820	12,599,876	8,186	5,309,703	13,310,413
New Jersey	114	825,375	900	313,611	1,116,884
Pennsylvania	1,212	22,677,322	16,674	10,005,505	31,642,390
Delaware	75	242,175	322	143,979	430,447
Maryland	203	1,735,837	1,979	1,043,346	2,750,339
Virginia	804	9,839,646	12,190	3,339,475	13,040,860
North Carolina	1,212	10,068,358	14,491	4,470,020	15,731,379
Total	6,428	88,840,657	77,789	39,738,929	116,235,401
Georgia	793	10,717,[illegible]58	15,364	2,996,891	14,435,563
South Carolina	439	7,237,725	9,656	1,617,713	6,791,451
Florida	198	11,556,330	10,408	2,870,497	10,901,650
Alabama	590	12,625,688	14,682	3,909,616	15,939,814
Mississippi	.618	23,439,225	21,233	5,893,360	24,035,539
Louisiana	421	37,385,028	26,353	8,796,944	35,192,374
Texas	299	18,426,242	13,332	3,642,484	16,278,240
West Virginia	633	12,442,475	10,460	3,763,461	14,933,472
Total	3,991	133,830,371	121,488	33,490,966	138,508,103

The agricultural industries constitute a fourth source of traffic. The following table (No. XX), compiled from the reports of the United States Department of Agriculture, shows the production in 1909 of corn, wheat, oats, barley, rye, buckwheat, potatoes, hay, tobacco, swine, sheep, and cattle. The aggregate farm value of these products in the States mentioned is reported at $688,000,000. This, moreover, does not include the truck farming and gardening output, which is of vast proportions in these States, and, in the case of New Jersey, is regarded as one of the probably important items of traffic for the proposed canal.

TABLE XX.—*Agricultural products, 1909.*

[In thousands.]

State.	Corn.	Wheat.	Oats.	Barley.	Rye.	Buckwheat.	Potatoes.	Hay.	Tobacco.	Swine.	Sheep.	Cattle.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Tons.*	*Pounds.*	*Number.*	*Number.*	*Number.*
New Jersey	9,483	1,969	1,530	....	1,288	283	7,200	546	....	152	44	272
Pennsylvania	48,800	26,265	25,948	196	5,508	5,655	23,790	3,742	30,732	931	1,000	2,057
New York	24,120	8,820	37,365	1,910	2,720	7,512	52,560	5,002	7,050	656	825	2,660
Delaware	6,200	1,652	102	....	14	40	864	109	....	46	7	60
Maryland	21,980	11,165	711	32	282	149	2,800	356	17,750	273	125	298
Virginia	47,328	8,848	3,800	86	184	378	5,520	606	120,125	774	365	875
Connecticut	2,460	....	302	....	187	58	4,320	564	22,110	47	38	218
Rhode Island	365	....	50	....	....	....	750	68	....	13	8	36
Massachusetts	1,786	....	217	....	65	58	4,250	673	7,040	68	35	280
Vermont	2,405	25	2,608	450	31	176	4,650	1,009	335	95	229	495
New Hampshire	1,053	....	441	50	....	44	2,730	621	170	51	74	215
Maine	646	230	4,588	228	....	664	29,250	1,330	....	62	254	314
North Carolina	48,686	5,415	3,234	....	122	99	1,850	242	144,000	1,356	215	746
Total	215,312	64,389	80,896	2,952	10,401	15,116	140,534	14,958	349,312	4,524	3,219	8,526
Value	$159,740	$71,900	$41,190	$2,092	$8,378	$10,457	$80,565	$224,668	$34,402	$39,417	$17,388	$248,197

IV. Barge Traffic of the North Atlantic.

Though the use of the proposed waterway will not be confined to barges, it will be primarily a barge canal. The present amount of this traffic and its various special features and advantages may well be considered in this report.

Table No. VII, compiled from the United States Census report on water transportation, shows that in 1906 there were 8,699 unrigged craft, with a gross tonnage of 2,260,622 tons, employed on the Atlantic and Gulf coasts. The gross tonnage of these barges and canal boats exceeded that of steamers engaged in carrying passengers and freight by 1,214,811 tons, and of sailing vessels thus employed by 1,154,721 tons. They comprised 46.6 per cent of the total gross tonnage of the Atlantic and Gulf coasts. The sailing tonnage, moreover, includes 323,618 gross tons of "schooner barges" which are equipped with sail but are towed. They are the "seagoing barges" employed largely on the North Atlantic in the carriage of coal, building materials, and other bulky materials, and many of them are especially suited to a large and improved inland waterway.

A large portion of the unrigged craft are in the harbor service, but many are also employed in the movement of freight between ports. The following table (No. XXI) shows the number of barges enrolled at some of the leading ports immediately adjacent to the proposed canal. These craft comprise mainly the documented barges engaged in the coastwise business. They do not include the undocumented craft, which comprise over 78 per cent of the unrigged craft of the Atlantic and Gulf coasts.

Table XXI.—*Documented canal boats and barges of ports adjacent to the proposed canal.*

State.	Number.	Gross tonnage.	Average gross tonnage.
Maine	12	5,389	449
New Hampshire	13	1,341	103
Vermont	7	716	102
Massachusetts	23	8,161	355
Rhode Island	7	1,602	229
Connecticut	151	45,154	299
New York	2,394	529,777	221
New Jersey	205	55,389	270
Pennsylvania	167	64,574	386
Delaware	14	4,955	354
Maryland	111	28,670	258
Virginia	34	13,690	402
North Carolina	17	1,091	64
Total	3,155	760,509	241
United States (total)	4,335	928,455	214
United States (barges)	3,590	847,504	236
United States (canal boats)	745	80,951	108

There has been within recent years a marked increase in the relative number and tonnage of barges. The returns of the United States commissioner of navigation show that for the country as a whole there has been a steady decline of the documented sailing tonnage from 4,622,609 tons in 1861 to 1,711,076 in 1909. The gross tonnage of documented steamships during the same years increased from 710,463 to 4,749,224 tons. The introduction of barges is a more recent movement. From 213,156 gross tons in 1868 the tonnage of documented barges has increased to 847,504 in 1909.

The United States Census returns further show that the gross tonnage of all unrigged craft, documented and undocumented, increased from 4,973,356 tons in 1889 to 7,129,631 in 1906, and their number from 16,937 to 20,263. The movement, furthermore, has been primarily on the Atlantic and Gulf coasts, where the gross tonnage of all unrigged craft grew from 623,483 gross tons in 1889 to 2,260,622 in 1906, or by 262.6 per cent. Their number increased from 3,425 in 1889 to 8,699 in 1906, or by 154 per cent, and their value from $7,837,440 to $41,658,685, or by 431.5 per cent. As previously mentioned, the sailing tonnage, moreover, includes 389 schooner barges with a gross tonnage of 323,618 tons. The following table, compiled from the census reports of 1889 and 1906, shows that this increase in barge traffic has been within recent years, in every respect, more rapid on the Atlantic and Gulf coasts than the increase in steam traffic. It likewise emphasizes the absolute as well as relative decline of sailing vessel tonnage.

TABLE XXII.—*Relative growth of unrigged craft on Atlantic and Gulf coasts, United States Census.*

Item.	1889	1906	Per cent of change.[1]
Steam vessels .... number..	2,536	5,413	+113.4
Sailing vessels .... do....	6,277	5,920	− 5.7
Unrigged craft .... do....	3,425	8,699	+154.0
Gross tonnage:			
Steam .... tons..	741,770	1,457,894	+ 96.5
Sailing .... do....	1,293,192	1,132,905	− 12.4
Unrigged .... do....	623,483	2,260,622	+262.6
Value of vessels:			
Steam	$65,518,640	$193,926,327	+196.0
Sailing	$42,685,982	$37,520,903	− 12.1
Unrigged	$7,837,440	$41,658,685	+431.5

[1] Decrease, −; increase, +.

The decline in sailing tonnage and increase in barge and steam tonnage is shown also in the following table (No. XXIII), which is based on the "Record of American shipping," and includes only domestic seagoing coastwise vessels:

TABLE XXIII.

Vessels.	1891		1901		1911	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
Sail	1,347	615,885	741	430,199	594	404,237
Barge	8	7,976	95	83,061	160	157,502
Steam	120	180,670	97	151,937	145	283,393
Total	1,502	804,476	933	675,197	899	845,132

Barges and schooner barges are a distinct development in coastwise water transportation. The latter are devised to partly overcome the danger of the open-sea route. They are rigged with short masts and a limited amount of sail, so that they may not be entirely helpless in case they break away from their towing steamer or tug. They are largely responsible for the marked decline in the use of sailing vessels for coastwise coal, lumber, phosphate rock, and other bulky cargo.

The conversion of the steam collier fleet of the Philadelphia & Reading Railway into a fleet of schooner barges is a striking instance in which the schooner barge has displaced the steamer, As is stated by the Bureau of Corporations, "with the development of other types of vessels, the time consumed in receiving and discharging cargo and the expense of the larger crew continuously maintained placed these steam colliers at a disadvantage. They were, for the most part, sold or converted into schooner barges, while their place has been taken by a fleet of tugs and schooner barges."

Advantages of barges as means of transportation.—Barges and schooner barges have various distinct advantages over sailing vessels and steamers. First, their initial cost is smaller. The inland barges are built to obtain the greatest possible capacity upon a given depth of water; but, being towed and used strictly for freight, they are not built with beauty of design. Seagoing barges are larger, but are likewise built for economy. Numerous sailing vessels and some steamers have, at small expense, been converted into seagoing barges.

Second, they are towed by tugs or steamers, singly or in fleets of two or three. Inland barges are sometimes towed in fleets of as many as six barges. This means that the costly machinery of the tug serves to transport several craft, just as the locomotive hauls a train of cars. Likewise the tug can be more continuously employed than can either the steamer or sailing vessel. While the barges which it has brought to port are being loaded or unloaded, it can return to its point of origin with another fleet of empty or loaded barges.

Third, this constant employment of motive power results in a higher degree of efficiency. As is reported by the United States Bureau of Corporations, "The efficiency of the schooner barge in the coal movement is illustrated by the comparisons

of the new Philadelphia & Reading fleet of 11 tugs and 63 barges with the former fleet of 15 steam colliers of the same line. The average carrying capacity of the steam collier was 1,200 tons, the average of the barges is 1,600 tons, and the class A barges have a capacity of 3,300 tons. The old fleet could, in about 500 voyages, deliver approximately 600,000 tons a year, while the schooner barges in 300 voyages from Philadelphia to eastern ports and return, aggregating about 1,150 barge cargoes, can deliver 2,400,000 tons of coal in 12 months."

Fourth, economy results also from the small number of men in a barge crew. Being towed, each barge in a fleet of even the large seagoing schooner barges is manned by a crew of but three or four men.

Fifth, as compared with sailing vessels, the seagoing as well as the inland barge lines have the advantage of greater regularity of service. Inland barges, however, can be relied on within closer limits than seagoing barges, because they are not hindered to any great extent by the storms and heavy seas which the latter too frequently encounter.

The advantage in dollars and cents of the barge over the schooner is shown in the following comparative statement of relative costs and operating expenses of a schooner carrying 1,000 tons dead weight or 500,000 feet of lumber via the outside route and a barge of similar capacity via the outside route:

TABLE XXIV.

	Schooner, outside route.	Barge, outside route.
Cost of construction	$40,000.00	$15,000.00
Crew and provisions, per month	445.00	90.00
Insurance per annum	2,800.00	637.50
Depreciation	2,000.00	750.00
Freight—lumber from Virginia (other commodities in comparison)	3.00–3.50	2.00–2.25

Barge transportation is particularly adapted to bulky freight, such as coal, lumber, sand, stone, gravel, fertilizers and phosphate rock, lime, cement, ice, grain, farm produce, brick, tile, terra cotta, iron ore, pig iron and steel, structural iron, railroad ties, paper and wood pulp, hides, and similar products which are available for carriage on the north and south Atlantic coasts. On an inland route the barges are suitable also for package freight, for such barges are protected from the seas and have the advantage of regularity and safety to almost the same extent as regular line steamers.

The economy of using barges over shipping by rail is partly shown in the comparison of the rates on typical commodities when moving, respectively, by rail or by barges. Table XXV contains a large number of such comparisons. Most of them are made with exactness, but in some instances the barge and rail rates are not quoted on the same basis. In such cases the actual railroad rates were converted into an approximate equivalent of the barge rates. In doing so a cord of pine or pulp wood was rated at 3,500 pounds, a thousand feet of green or wet southern pine at 3,500 pounds, and a railroad tie at 150 pounds. The actual railroad rates are, however, included in the table.

Great as is the balance in favor of the barge lines, as shown by these relative rates, the difference would be somewhat greater in case the proposed waterway were constructed. As compared with the barges now using the inland route, the 2,000-ton barge could, because of its far greater capacity, carry its freight at a lower rate. Two other factors, considered in other parts of this report, likewise would tend toward lower rates than rule at present. The one relates to the tolls which are now charged by the inland canal companies and which would be removed on a free Government waterway. The other refers to the reduced marine insurance rates on barges and barge cargoes when using an inland route. They are now from 50 per cent to 75 per cent lower than via the outside route. Coastwise barges are obliged to pay from 8 per cent to 12 per cent or go uninsured and protect themselves when possible by higher rates of freight.

It is estimated that a 1,000-ton barge, loading 75 per cent capacity cargo (750 tons), can be profitably operated through the proposed free ship waterway across the State of New Jersey, between Philadelphia and New York, at an average rate of freight of 45 cents per ton of 2,000 pounds. (See Exhibit "A," Appendix C.)

In like manner a 2,000-ton barge, loading 60 per cent capacity cargo (1,200 tons), could be operated at an average freight of 35 cents per ton of 2,000 pounds. (See Exhibit "B," Appendix C.)

Terminal charges are not embraced in the above freight rates.

TABLE XXV.—*Comparative rail and barge rates.*

Commodities.	Origin and destination.		Barges.	Equivalent freight rates in cents per 100 pounds to barge rates per 1,000 feet or per ton, as specified.	Rail freights to or from destinations specified.	Equivalent to rail rates per 1,000 feet or per ton, as specified.
	From—	To—	Rate of freight.			
Lumber	Jacksonville	Philadelphia	$4.75 to $5 per 1,000 feet	13.57 cents per 100 pounds	22 cents per 100 pounds	$7.70 per 1,000 feet.
Do	Savannah	do	do	do	23 cents per 100 pounds	$8.05 per 1,000 feet.
Do	Norfolk	do	$2 per 1,000 feet	$1.14 per 2,000 pounds	$1.80 per ton 2,000 pounds	$3.15 per 1,000 feet.
Do	Newberne	do	$2.75 to $3 per 1,000 feet	7.86 cents per 100 pounds	16 cents per 100 pounds	$5.60 per 1,000 feet.
Do	Baltimore	do	$2 to $2.25 per 1,000 feet	$1.14 per 2,000 pounds	$1.80 per ton 2,000 pounds	$3.15 per 1,000 feet.
Sand	Philadelphia	Baltimore	75 cents per ton 2,000 pounds	75 cents per ton 2,000 pounds.	$1.25 per ton 2,000 pounds	$1.25 per ton 2,000 pounds.
Do	do	New York	85 cents to $1 per ton 2,000 pounds	85 cents per ton 2,000 pounds.	$1.60 per ton 2,000 pounds	$1.60 per ton 2,000 pounds.
Do	do	Norfolk	75 cents per ton 2,000 pounds	3.75 cents per 100 pounds	11 cents per 100 pounds	$2.20 per ton 2,000 pounds.
Railroad ties	Norfolk	Philadelphia	11 to 12 cents per tie	6.28 cents per 100 pounds	9 cents per 100 pounds	15$\frac{3}{4}$ cents per tie.
Railroad iron	Baltimore	do	$1.25 per ton 2,240 pounds	5.58 cents per 100 pounds	10 cents per 100 pounds	$2.24 per ton 2,240 pounds.
Pig iron	Norfolk	do	95 cents to $1 per ton 2,240 pounds	95 cents per 2,240 pounds	$1.95 per ton 2,240 pounds	$1.95 per ton 2,240 pounds.
Pine wood	do	do	$2 per cord	5.71 cents per 100 pounds	11 cents per 100 pounds	$3.85 per cord.
Pulp wood	do	do	$1.80 per cord	$1.03 per 2,000 pounds	$2.20 per ton 2,000 pounds	Do.
Fertilizer	Philadelphia	Norfolk	$1 to $1.25 per ton 2,000 pounds	$1 per 2,000 pounds	$1.60 per ton 2,000 pounds	$1.60 per ton 2,000 pounds.
Coke	do	Baltimore	80 cents per ton 2,000 pounds	80 cents per 2,000 pounds	$1.20 per ton 2,000 pounds	$1.20 per ton 2,000 pounds.
Do	do	Norfolk	$1 per ton 2,000 pounds	$1 per 2,000 pounds	$2 per ton 2,000 pounds	$2 per ton 2,000 pounds.
Stone	Port Deposit	do	40 to 50 cents per ton 2,000 pounds	40 cents per 2,000 pounds	$1.90 per ton 2,000 pounds	$1.90 per ton 2,000 pounds.
Brick	Philadelphia	do	90 cents to $1 per ton 2,000 pounds	90 cents per 2,000 pounds	$2.20 per ton 2,000 pounds	$2.20 per ton 2,000 pounds.
Cinders	do	New York	85 cents to $1 per ton 2,000 pounds	85 cents per 2,000 pounds	$1.90 per ton 2,000 pounds	$1.90 per ton 2,000 pounds.
Coal	do	Boston	65 to 75 cents per ton 2,240 pounds	65 cents per 2,240 pounds	$2.65 per ton 2,240 pounds[1]	$2.65 per ton 2,240 pounds.
Do	do	Providence	55 to 60 cents per ton 2,240 pounds	55 cents per 2,240 pounds	$2.70 per ton 2,240 pounds	$2.70 per ton 2,240 pounds.
Do	do	Norfolk	40 to 50 cents per ton 2,240 pounds	40 cents per 2,240 pounds	$2 per ton 2,240 pounds	$2 per ton 2,240 pounds.
Do	do	New York	60 to 75 cents per ton 2,240 pounds	60 cents per 2,240 pounds	$1.95 per ton 2,240 pounds	$1.95 per ton 2,240 pounds.
Do	do	Newberne	75 cents per ton 2,240 pounds		No rate	
Do	do	Savannah	90 cents per ton 2,240 pounds		do	
Do	do	Charleston	do	90 cents per 2,240 pounds	$5 per ton 2,240 pounds	$5 per ton 2,240 pounds.
Do	do	Jacksonville	do	do	do	Do.
Do	do	Portland, Conn.	70 to 80 cents per ton 2,240 pounds		No rate	
Do	do	Portsmouth	do	70 cents per 2,240 pounds	$3.15 per ton 2,240 pounds	$3.15 per ton 2,240 pounds.

[1] Railroad rates on coal are from Shamokin, Schuylkill district.

NOTE.—Figures of lowest barge rate used. The two outer columns are to be compared to get equivalent rates by barge and rail.

It is estimated that, availing of the most modern, comprehensive, up-to-date loading and discharging facilities, 25 cents per ton of 2,000 pounds would cover handling of cargo into and out of barges, divided 10 cents per ton for loading and 15 cents per ton for discharging. This would make the total transportation charges payable by the shipper 60 to 70 cents per ton.

Barges operated as above, it is estimated, would net their owners, respectively, 23.2 per cent and 20.8 per cent per annum upon capital invested.

Barge and railroad transportation may also be compared as regards time taken in transit. One of the most frequent complaints of shippers and consignees is that of delays in rail deliveries. A large manufacturer of Riverside, N. J., for example, writes: "Our trade with the East is very seriously hampered by slow deliveries on the part of the railroad companies on account of congestion in and around New York and the necessity of transfers between connecting roads to reach New England points." A heavy shipper of Camden, N. J., writes: "We find it almost impossible to make prompt deliveries on New England shipments from Philadelphia by present facilities. Boat connection by an inside route between here and New England will be of the greatest possible service for prompt deliveries and lower freight, except in such inland towns throughout New England or eastern New York State where it would be necessary to make transfer for a long haul." A Philadelphia lumber dealer writes: "The time of delivery by water is always more exact and less unreliable than railroad time of delivery." A Philadelphia shipper of brass goods says: "Water transportation can be relied on for deliveries; the railroads can not. The canal would cut down the time to Boston by one day, and shipments to New York could be made over night." A concrete company of Philadelphia writes: "We find the water route much quicker than the railroad to all coast points."

Similar statements were received to the effect that the canal would reduce present delays in coastwise water transportation. A large New York shipper writes that he is "now delayed by weather, entailing losses amounting to thousands of dollars," and that this "condition would be relieved by the canal." A shipper of Chester, Pa., writes that the "canal would save two days on a round trip between Cape Breton and Chester, and would avoid bad weather." A Philadelphia manufacturer writes that the canal "would cut down the delay of getting through steamers from Boston," as he "could use sound steamers to New York and transship." The effect of the canal upon delays would influence not only barges, but all steamers that might use the canal route.

DEPENDENCE OF BARGE TRANSPORTATION UPON AN INLAND ROUTE.

1. Water shipments are now restricted by the scarcity of sailing vessels. A large Philadelphia coal company writes that it is "seriously hampered by the scarcity in sailing vessels, of which there is a marked falling off." A large pipe and foundry company of New Jersey writes: "It is frequently necessary to wait a week or more before suitable sailing vessels can be obtained." There are examples of other complaints made as to the scarcity of sailing vessels.

2. Barges engaged in the coastwise trade suffer from the lack of an adequate inland route. The list of disasters during the 10 years ending in 1910 to vessels engaged in the coastwise trade of the Atlantic and Gulf coasts is only a partial index to the dangers encountered. Table No. XXVI, compiled from the revised reports of the Life-Saving Service, however, shows that during the decade 1900 to 1909, 5,715 disasters were officially reported, involving a known vessel loss of $30,380,915 and a known cargo loss of $10,168,640, a known tonnage of 483,741 was totally lost, and 3,289,200 tons were damaged. The figures of value, moreover, are not complete; those stating loss to vessels included but 539 disasters in 1909, and those showing loss to cargoes included but 125 disasters. But it is noteworthy that the known loss to cargoes and vessels during the decade ($40,549,555) is in excess of the estimated cost of building the proposed waterway with a depth of 18 feet and a width of 125 feet ($32,250,000). In addition to the heavy loss of property, the Life-Saving Service reports from 49 to 1,147 lives lost annually in the Atlantic and Gulf coastwise service, a total of 2,223 for the decade—certainly a heavy toll of human lives.

TABLE XXVI.—*Disasters to vessels on Atlantic and Gulf coasts during the period July 1, 1899, to June 30, 1909.*

Year.	1909	1908	1907	1906	1905	1904
Number of vessels	539	575	687	492	550	558
Loss of vessels (known)	$3,379,825	$3,171,680	$3,162,515	$2,312,010	$3,259,985	$2,898,235
Loss of cargoes (known)	$1,377,295	$841,680	$692,175	$764,150	$1,219,360	$603,505
Vessels totally lost (known)	103	177	215	137	165	173
Vessels damaged (known and unknown)	436	398	472	355	385	385
Tonnage totally lost	48,013	47,340	65,685	29,147	48,966	48,446
Tonnage damaged	395,375	454,849	386,166	292,658	271,063	313,018
Lives lost	60	54	334	76	86	1,147

Year.	1903	1902	1901	1900	Total, 1900–1909
Number of vessels	540	621	571	582	5,715
Loss of vessels (known)	$2,646,490	$3,186,050	$1,943,435	$4,420,690	$30,380,915
Loss of cargoes (known)	$660,485	$1,097,375	$669,890	$2,242,725	$10,168,640
Vessels totally lost (known)	166	185	175	179	1,675
Vessels damaged (known and unknown)	374	436	396	403	4,040
Tonnage totally lost	44,989	63,554	35,585	52,018	483,743
Tonnage damaged	289,551	287,443	295,071	304,006	3,289,200
Lives lost	87	73	49	257	2,223

Table No. XXVII classifies the above disasters of 1908 and 1909 according to the type of vessels. The number of barges wrecked is far less than of schooners and steamers, because only a small portion of the barge fleet uses the open-sea route, and these start upon a voyage only under favorable conditions. The disasters to steamers and schooners indicate to some extent, however, the risks that would be encountered if the entire barge fleet were deprived of an inland route.

TABLE XXVII.—*Classes of vessels lost or damaged on Atlantic and Gulf coasts.*[1]

Class of vessel.	Number of vessels.		
	1909	1908	1907
Barges	44	74	51
Barks	5	3	21
Barkentines	6	4	4
Brigs	....	2	....
Brigantines	1	3	....
Dredges	1	....	....
Ferryboats	25	13	28
Schooners	172	220	299
Scows	6	5	3
Ships	....	1	1
Sloops	6	15	20
Steamers	223	195	208
Steam canal boats	....	1	....
Steam yachts	11	7	8
Yachts	1	3	2
Unknown	....	....	6
Total	501	546	651

[1] Figures from regular reports of Life-Saving Service, the totals of which do not agree with the revised figures of Table XXVI.

TABLE XXVIII.—*Causes of disasters to vessels on Atlantic and Gulf coasts (1909).*[1]

Cause.	Number of vessels.	Cause.	Number of vessels.
Calms, currents, and tides	9	Explosion	5
Darkness	3	Fire	53
Fog	32	Ice	1
Gales, hurricanes, etc	58	Missed stays	4
Heavy seas	10	Sprung a leak	17
Snowstorms	6	Struck bridge, pier, rock, etc	33
Error in compass	1	Water logged	1
Error of officers, masters, and crew	16	Collisions	220
Error of pilots	3	Miscellaneous	9
Damage to machinery	7	Unknown	6
Absence of buoys	5		
Capsized	2	Total	501

[1] Figures from regular reports of Life-Saving Service, the totals of which do not agree with the revised figures of Table XXVI.

The recent loss of 17 lives and 3 coal barges of the Reading Coal & Iron Co.'s fleet is still fresh in the public mind. The barges *Trevorton, Corbin*, and *Pine Forest*, in tow of the tug *Lykens*, bound from Philadelphia to New England coal ports, encountered two serious coast storms. Barely surviving the first, they were completely wrecked by the second in full sight of three life-saving crews, who were unable to render assistance to the helpless captains and crews in the raging seas.

Appendix B contains a detailed list of the leading wrecks, involving total loss of vessel, which occurred during the years 1906 to 1910, inclusive, on the Atlantic and Gulf coasts. Appendix B is thus not comparable with the Tables XXVI and XXVII. The accompanying chart graphically shows the points at which the wrecks occurred on the coast from Portland, Me., to Cape Hatteras during these years.

MARINE INSURANCE.

The large annual loss of life and property in the coastwise business emphasizes the importance of marine insurance. Seagoing barges are such poor risks that marine insurance companies will not insure them except at very high rates. Coastwise sailing vessels have long complained of the difficulty of getting insurance, and it is regarded as one reason for their decline. Outside barges are in much the same position, for many are refused all insurance. The rates on barge hulls, on the outside route, range from 8 per cent to 12 per cent annually, as compared with an average of 4 per cent on the inside route. If staunch seagoing barges were provided with an inside route the difference would be even greater, because they would be a better risk than the average inland barge at present engaged in the trade between Atlantic ports. As it is at present the insurance rates are so high that many barges go uninsured, and their owners either bear the risk of loss or attempt to protect themselves by charging higher rates. Some barges carry only fire insurance and go unprotected against other more serious marine risks. Some of the barge lines consulted regard the difficulty of obtaining insurance and the danger of the open-sea route as the prime obstacle confronting them. There are instances where barges are sent through the Delaware & Raritan Canal partly loaded in preference to sending them via the outside route because of the risk involved. The marine insurance companies, on their side, claim that even at high rates they are not eager to insure seagoing barges.

Cargo insurance is usually, though not always, left to the shippers and consignees. It is stated that the insurance rates on perishable goods or any cargo that can be damaged by water are prohibitory, or insurance is refused. Lumber, coal, and similar bulky cargoes are accepted, but at high rates. An official of a large marine insurance company stated that the average rates per trip on acceptable cargoes are about one-half per cent between New York and Philadelphia via the outside route, as compared with one-fourth per cent via the Delaware & Raritan. These inside rates would perhaps be somewhat lower in case a canal for larger barges were provided. Comparisons with the insurance rates on steamship cargoes are difficult because of the difference in kind of cargoes carried. The rates on lumber carried from Savannah to Philadelphia, however, are usually one-eighth of 1 per cent per trip, as compared with 1½ per cent when carried by barges. These rates are given as fairly representative of the difference between cargo insurance rates on steamers as compared with seagoing barges. The cargo insurance rates on inside barges are at present about 50 per cent less via the open sea.

The present canals paralleling the North Atlantic are wholly inadequate to meet the demands of barge traffic. The Delaware & Raritan has a depth of 8 and 9 feet, with a vessel draft of 7 feet, and the Chesapeake & Delaware a depth of 10 feet, with a vessel draft of 9 feet. The former carried 401,231 tons of freight in 1909, and the latter 818,386 tons. The traffic of the Delaware & Raritan declined from 2,837,532 tons in 1872, and that of the Chesapeake & Delaware from 1,318,772 in 1872. Southward from these canals are the Dismal Swamp and Albemarle & Chesapeake Canals, which afford a gateway to Newburn, N. C., but their depth is likewise 9 feet.

The decline of traffic on the Delaware & Raritan is evidence neither of any lack of demand for canal transportation nor of the inability of the proposed waterway to handle large quantities of freight. The Delaware & Raritan was defeated largely by its inadequate dimensions. The carload and trainload of freight and the railroad locomotive have continually increased in proportions, while the inland barge has long been limited by the dimensions of this canal and those to the south. Railroad transportation has become more economical, while that of the Delaware & Raritan has, if anything, become less so, for it has been allowed to deteriorate, high tolls have been levied, and it is closed to navigation during a long winter season. Since 1871, when it was leased for 999 years, it has been operated by the Pennsylvania Railroad.

In addition to its small dimensions and scanty maintenance, the Delaware & Raritan Canal levies canal tolls. The rates of toll between Bordentown and New Brunswick vary from 35 cents per 2,240 pounds on sixth-class freight to $1.50 on first class freight. On way freight the charges vary from 1 cent per 2,240 pounds per mile on sixth-class freight to 3 cents 5 mills ($0.035) on first-class freight. It is specified, however, that "boats carrying full cargoes of fifth and sixth class freight one way will be free of boat tolls and lockage, both going and returning, excepting way boats, which will be charged $1 each way for passing Wells Falls outlet lock."

Rates of toll on Delaware & Raritan Canal.[1]

Governed by official classification.	Between Bordentown and New Brunswick per 2,240 pounds.	Between way points per mile per 2,240 pounds.
First-class freight	$1.50	$0.035
Second-class freight	1.20	.030
Third-class freight	.70	.025
Fourth-class freight	.45	.015
Fifth-class freight	.40	.012
Sixth-class freight	.35	.010

[1] Except coal and coke.

Towage charges are also regularly published. From Philadelphia, for example, to Bordentown they are 8 cents per ton of 2,240 pounds; to Keyport, 25 cents; Perth Amboy, 15 cents; Newark, 25 cents, and Hudson City, 26 cents. These tolls and towage charges have deterred many from using the canal. A Philadelphia lumber dealer, for instance, writes: "We have often tried the canal, but toll and towing charges make it prohibitory." A shipper of Chester, Pa., writes: "We can not use the canal for manufactured goods because of high toll charges."

On through shipments to or from the South, the Delaware & Raritan, moreover, depends upon the Chesapeake & Delaware Canal, and here, likewise, tolls are levied. On barges carrying ashes, clay, sand, manure, or shells the tolls are 15 cents per ton; on common brick, 20 cents per ton; fire brick, 30 cents per ton; coal, 15 cents per 2,240 pounds; fertilizers, from 15 to 50 cents per ton; pig iron, 20 cents per ton; lumber, 30 cents per 1,000 feet; posts (locust, cedar, oak, or chestnut), $1.25 to $1.50 per 100; railroad ties, 2 cents each; stones, 15 to 30 cents per ton; wood, 30 to 35 cents per cord, and timber piles, 15 to 35 cents each. These are sufficient to illustrate the general level of the tolls of this canal.

An inland waterway large enough to accommodate a barge of 2,000 tons or more is in an entirely different category than the present canals of the North Atlantic, the largest craft of which are of 700 and 800 tons. The present operation of these barges on the open sea at owner's risk indicates the inadequacy of the present canals and the urgent need for an inland route of larger dimensions, better maintenance, and freedom from heavy tolls.

EXPANSION OF BARGE TRANSPORTATION BY PROPOSED CANAL.

The above-mentioned facts are sufficient to show that a large majority of the barges at present engaged in the traffic of the North Atlantic would use the proposed canal. The committee has received abundant assurances that existing barge lines would use the inland route with all but their very largest seagoing barges, which could not move through an 18-foot canal. A large New England barge line writes: "All our outside barges, excepting our two largest, could use this proposed canal, and it would be a great advantage to us to be able to use it. It would not only avoid the danger of the sea route for our outside barges, but would also enable us to send our smaller barges to Philadelphia that now load at New York ports. We transport coal almost entirely in our barges, with occasional cargoes of pig iron from southern ports, and we transport annually about 350,000 to 400,000 tons. Practically all this amount could be shipped through this canal." The prospective tonnage of a single barge line, therefore, equals the entire tonnage of the present Delaware & Raritan Canal.

A prominent New Jersey transportation line writes: "We are in a position to state that we could save between 30 and 60 days annually if we were in a position to send our vessels through canals. We have been delayed several times at Delaware Breakwater, Vineyard Haven, Sandy Hook, Cape Henry, and Baltimore, entailing considerable loss to us. The cost of insurance is prohibitive, and if such a state of affairs continues I am unable to tell where our marine business will land."

Not only would a large share of the barges at present plying between Atlantic coast points use the proposed canal, but transportation companies would in many cases expand their business by adding more barges. Various barge lines at present operating chiefly from Chesapeake Bay points to Philadelphia either do nothing to encourage shipments to New York and New England points, or refuse such shipments because of the inadequacy of the Delaware and Raritan Canal and the dangers of the outside route. They state that their services would be extended materially in case an adequate inland route were provided.

New barge lines would be organized if an inland route were provided. Even under present conditions there has been a marked shifting in coastwise tonnage from sailing vessel to barge, and, to a less extent, from steamer to barge. This movement would increase if barge transportation were made safer and cheaper by the construction of an inland route. A Philadelphia towing company, for example, writes: "We feel convinced that our business will be increased 100 per cent after the building of such a canal owing to the tonnage that would ply in the same." A large shipper of Chester, Pa., interested in steamers, writes: "If such a canal is constructed we shall probably build several power barges for use in business which the canal would make possible." A large shipper of Philadelphia and owner of barges writes: "We are convinced, from our experience in the coal trade covering a period of many years, that the proposed canal would be a great benefit, both to consumers and shippers alike, provided the proposed Narragansett Bay and Cape Cod Canals are constructed in conjunction therewith; in that, in the long run, it would tend to lower rates of freight and insurance, effect a saving in time, and provide safer transportation. This is assuming that the proposed canal would be open to navigation at all times during the year and free also from all tolls."

A large shipbuilding concern writes: "The construction of the inland waterways along the Atlantic seaboard would, we believe, stimulate the building of barges, tug boats, freight packets, and steamers for the transportation of freight through these waterways until as regular and as well-established lines between points adjacent to these waters would be established and maintained as now exist on Long Island Sound or on the Delaware River and Bay; and by such means the cost of transportation and insurance on raw material and manufactured products would be greatly reduced and thereby increase the business of not only this seacoast section, but of the entire country. With canals such as that proposed across New Jersey the question of transportation at reasonable rates would soon be solved by the establishment of regular freight packet lines such as now ply between Wilmington and Philadelphia, New York, and points on Long Island Sound, and such as once plied between Wilmington and New York, for shipments of less than full cargoes, and by barges in regular tows or by special tugs for full cargoes."

V. FREIGHT CARTAGE AT PHILADELPHIA.

The above comparison of barge rates with railroad rates fairly describes the relative cost of transportation as between railroad freight delivered over private sidings and barge freight which requires no cartage at the terminals. This covers a very considerable portion of both rail and water shipments. The Pennsylvania Railroad has

approximately 360 sidings in Philadelphia, the Philadelphia & Reading 350, and the Baltimore & Ohio 100. But, on the other hand, there are many industrial wharves at which cargoes are shipped and discharged directly, and at other ports, particularly Baltimore and most of the smaller ports, the industrial wharf is relatively more important than in Philadelphia. On such direct shipments the cost of shipping by barge, as seen in Table XXV, is materially lower than by rail.

A second condition exists as between rail and barge shipments when both of them require cartage at the terminals. Though there are over 800 railroad sidings in Philadelphia, the United States Census Office in 1905 reported over 7,000 manufacturing establishments. Essential parts of every railroad station are regular receiving and delivery platforms, warehouses, and team tracks for direct loading and unloading between cars and trucks.

There is sufficient hauling in Philadelphia to support a large public cartage business. There are approximately 5,000 teams regularly employed by public teamsters in hauling freight to and from railroad stations and to and from the water front. Some of them haul any kind of freight offered at agreed charges; some confine themselves to special classes of freight and others lease a portion of their equipment to manufacturers. Some manufacturers who haul their finished products nevertheless hire public teamsters to handle their raw materials. In addition to the public cartage business, there is considerable hauling by the private teams of department stores and various manufacturers and merchants.

The cartage charge between the business districts and the railroads differ in some cases from those between the business districts and the waterfront, but their general level is not far apart. Cartage charges, therefore, do not vitally affect the comparison of costs as between railroad and barge shipments when both require hauling at the terminals. The difference is chiefly between the rail and the barge rates, and, as shown above, the latter indicate a large saving.

The third condition arises as between railroad rates over private sidings and barge rates on freight shipped or received that requires cartage. In such a comparison the cartage charge is the determining factor. The following table (No. XXIX) makes a comparison based on some of the leading commodities shipped both by rail and water. In some cases the sum of the barge rate and Philadelphia cartage charge is less, and in other cases it is greater than the rail rate over private sidings. In some shipments a cartage charge also arises at the terminal from or to which the barge plies in its Philadelphia shipments. Wherever such double cartage charges are paid the shipper with a private rail siding would gain nothing by using existing barge lines. In many cases, also, when but one cartage charge is to be paid the shipper with a railroad siding would gain little or nothing by shifting to barges with present barge rates.

TABLE XXIX.—*Relative cost of shipments at Philadelphia by rail and barge, including cartage in barge shipments.*

Commodity.	Cartage from water front to business districts.	Barge rates and cartage charge to business districts.	Railroad rates to and from private sidings.
Lumber (per 1,000 feet)	$0.75–$1.50	Norfolk to Philadelphia, $2.75 to $3.50	[1] $3.15
Railroad ties, per 100 pounds	.03	Norfolk to Philadelphia, $0.10 to $0.13 [2]	.09
Brick (common), per 2,000 pounds	[3] .45	Philadelphia to Norfolk, $1.35 to $1.45	2.20
Coal (per 2,240 pounds)	.50	Philadelphia to Boston, $1.30 to $1.35	[4] 2.65
Coke (per 2,000 pounds)	1.00	Philadelphia to Baltimore, $1.80	1.20
Sand (per 2,000 pounds)	.80	Philadelphia to Baltimore, $1.55	1.25
Pulp wood (per 2,000 pounds)	[5] .60–1.00	Norfolk to Philadelphia, $1.63 to $2.03 [6]	2.20
Pig iron (per 2,240 pounds)	[7] .67–1.12	Norfolk to Philadelphia, $1.62 to $2.07	1.95
Clay (per 2,000 pounds)	[8] 1.00	Philadelphia to New York, $1.85 to $2	1.85
Fertilizer (per 2,000 pounds)	.60–1.00	Philadelphia to Norfolk, $1.30 to $1.90	1.60

[1] 1,000 feet southern lumber rated at 3,500 pounds. Actual railroad rate, $1.80 per 2,000 pounds.
[2] Railroad ties rated at 150 pounds each. Actual barge rates, 11 cents to 16 cents per tie.
[3] 1,000 bricks rated at 4,500 pounds. Actual cartage charge, $1 per 1,000.
[4] From Shamokin, Schuylkill districts.
[5] Pulp wood at 3,500 pounds per cord. Actual cartage charge, 3 cents to 5 cents per 100 pounds.
[6] Barge rate, $1.80 per cord.
[7] Cartage charge, 3 cents to 5 cents per 100 pounds.
[8] Cartage charge, 5 cents per 100 pounds.

In case the proposed waterway were constructed, barge rates would, as shown previously, be somewhat lower than at present, and this would affect the comparison of barge plus cartage charges and present rail rates over sidings. Sufficient concessions, however, would doubtless be made by the rail carriers to retain the bulk of the freight handled over sidings.

The proposed canal, because of these cartage charges, can afford little if any saving as compared with freight handled over private sidings. It can, however, afford a large saving as compared with railroad freight which requires hauling to and from railroad stations, and on freight which can be discharged and loaded directly at industrial wharves.

VI. Water Terminal Facilities.

Adequate terminal facilities are an essential part of a waterway. Unless proper water terminals are provided at the ports so that barges, sailing vessels, and steamers plying between them in the coastwise trade can readily find wharves at which to load and discharge, there is little to be gained in building an inland waterway for their use. Unless practically the entire available shipments and receipts of any particular port are to and from large industrial concerns which have their own wharves, the port should either regulate private wharves so that they become available for general shipping or provide sufficient open public wharves. Since the former practice is probably not possible as a general rule, the public wharf is essential. Provision should also be made so that barges may as easily as possible run alongside the larger vessels in the various harbors to transship cargoes directly.

The work of providing terminal facilities should be assumed by the various municipalities. A proper division of responsibility would seem to be for the Federal Government to provide the channel, the State to provide the right of way, and the municipalities to provide the terminals, and each of the three parts is essential to the proposed waterway. The Federal Government might possibly be justified in making the appropriation for the building of the waterway contingent upon a guarantee by the interested municipalities that they will provide adequate terminal facilities.

Such guarantee would not be a serious hardship, for existing terminal facilities are at present accommodating a large coastwise traffic. Philadelphia has a total water frontage of 33.4 miles with a depth of 18 feet or over. Of these, 18.8 miles are on the Delaware and 14.6 on the Schuylkill River. The city of Philadelphia owns 37 different pieces of water front, including street ends, bulkheads, ferry slips, and wharves. On the Delaware River 1,402 feet are now controlled by the city and 2,196 feet are leased. Most of the leases, however, expire between the years 1912 and 1915. The city is therefore in a position at present to increase the number of its public wharves and piers on the Delaware, and will be still more so in the immediate future. It likewise owns 6,302 feet of water front on the Schuylkill River. It will be highly desirable for the city to construct wharves and piers at various places for some distance up the Delaware River throughout the manufacturing district which borders on the river so that barges and other craft using the proposed canal may find easy and direct access. This would eliminate a large amount of long-distance cartage.

The street ends owned by the city can be made available only for very small barges, but under an act of 1907 the city may, if it desires, condemn space at appropriate places along the water front.

The city of Philadelphia is taking steps to accommodate its growing commerce. Two piers are at present under construction and plans have been made for the future. The terminal plans at Philadelphia are made clear in the following statement of the director of wharves, docks, and ferries, with accompanying charts:

Department of Wharves, Docks, and Ferries,
Philadelphia, *February 8, 1911.*

Mr. Wilfred H. Schoff, *Secretary Commitee on Traffic.*

Dear Sir: In reply to your letter of the 6th instant, in which you request, on behalf of your committee, information concerning the improvements now under way and projected in Philadelphia Harbor, I have the honor to report that due consideration has been given all matters in connection with the improvements, and provisions will be made for the increased commerce and everything connected with the same, that will take place during the construction of the Intra-Coastal Canal connecting New York and Delaware bays, and following its completion.

At the present time there is under construction:

1. *Vine Street Pier.*—A double-deck concrete and steel structure supported on piles, for the heaviest trans-Atlantic traffic. This pier will be 166 feet wide and 571 feet long, and will be completed by November 1, 1911.

Substructure about 75 per cent completed. Amount of contract	$321,000
Superstructure; contract awarded. Amount of contract	339,000

2. *Dock Street Pier.*—A double-deck concrete and steel structure supported on piles, for trans-Atlantic traffic. This pier will be 120 feet wide and 582 feet long. Plans and specifications have been prepared for the pier, and the money for construction is authorized in the loan about to be negotiated.

Amount of contract	500,000
Total cost of piers under construction	1,160,000

The works contemplated are as follows:

3. *Catharine Street Pier.*—A double-deck concrete and steel structure supported on piles, for commercial and recreation purposes. This pier will be 140 feet wide and 570 feet long.

Approximate cost of pier	450,000
Cost of land	350,000
Total cost	800,000

4. *Allegheny Avenue Pier.*—A double-deck concrete and steel structure supported on piles, for commercial and recreation purposes. This pier will be 100 feet wide and 610 feet long.

Approximate cost of pier	290,000
Cost of 130 feet of dock space	100,000
Total cost	390,000

5. *Bridge Street Pier.*—A double-deck concrete and steel structure supported on piles, for commercial and recreation purposes. This pier will be 100 feet wide and 640 feet long.

Approximate cost of pier	304,000
Cost of land	100,000
Total cost	404,000

6. *Penn Treaty Park Pier.*—A double-deck concrete and steel structure supported on piles, for commercial and recreation purposes. This pier will be 80 feet wide and 467 feet long.

Approximate cost	211,600

As to the plan for future improvement of the harbor, I inclose herewith print submitted with my annual report for the year ending December 31, 1909, which shows proposed improvements on the Schuylkill River and near the mouth. My recommendations in that case have been adopted and will be incorporated in the comprehensive plan to be submitted to councils for their approval in the near future.

Further improvements on the Delaware River will, in all probability, be made between the back channel north of League Island and Greenwich Piers, where it is proposed to build long piers, such as shown on the plan submitted with my annual report for the year 1909, not exactly as indicated on that plan, but the idea submitted by me will be adopted to a large extent.

On the chart showing the Philadelphia Harbor I have indicated in red the sites of the piers under construction and the proposed piers. Number 7, near the mouth of the Schuylkill, shows the location of the land recently purchased by the city of Philadelphia for harbor improvements on the west bank of the Schuylkill River, in the vicinity of Penrose Ferry Bridge: 407 acres, with 2,526 feet of frontage on the Schuylkill River. Cost, $205,000.

Trusting this will give you the desired information, I am,

Very respectfully, yours,

J. F. Hasskarl,
Director (Acting).

A portion of the canal traffic can also be handled at the wharves and piers of the industrial concerns located on the water front, for they are themselves shippers and receivers of freight. They include various sugar refineries, a fertilizer company, salt manufacturer, ice company, several oil refineries, gas works, storage company, linseed-oil company, and the Cramp Ship & Engine Works. The railroad water terminals are likewise available to some extent. The various coal companies at present use the railroad piers. So do some of the regular coastwise and river boat lines, while others own their wharves or lease them from the city.

At the port of New York the city owns most of the North River water front on Manhattan Island from Sixty-seventh Street to the Battery, and on the East River as far as Corlears Hook Park. It also owns considerable frontage on the East River, from East Sixtieth to East Twenty-ninth Street and a limited amount on the Brooklyn side around Wallabout Basin. On the North River, from West Seventieth Street to the Battery, and up the East River to East Forty-second Street, there are 180 piers, and of these the city owns about 150 and partly owns from 5 to 10 others. Much of this city water front is leased. There are approximately 200 leases on the Manhattan water fronts, 158 of which are for periods extending over 10 years. While the most important city wharfage is thus covered by time leases, there are many leases of less importance which are at the pleasure of the commissioner of docks and can be made available for general use.

There are also various dock and terminal companies, a portion of whose water front is available. Such are the New York Dock Co., the Erie Basin and the Bush Terminal Co., whose wharves are south of Brooklyn Bridge; and the American Dock & Trust Co., which owns property on Staten Island.

Numerous piers and wharves are now used by industrial concerns which are prospective shippers and receivers of freight through the proposed waterway, and whose wharfage facilities are assured. On the East River (Manhattan) below One hundred and first Street there are 10 wharves for ice, 7 for coal, 4 for lumber, and 5 piers are occupied by gas works. On the Brooklyn side north of Dock Street and below Newtown Creek various industrial concerns have wharfage facilities. The United States Bureau of Corporations reports that "the banks of Newtown Creek are occupied almost wholly by industrial establishments and concerns engaged in commercial enterprise, such as lumber yards, coal depots, etc."

Baltimore has a total water front of 18 miles, of which the city owns 9 per cent, the railroads 17 per cent, and industrial concerns and private parties 74 per cent. The upper part of the harbor at present has "extensive wharfage used by coasting and other smaller vessels and bay steamers," and those concerns having their own wharves are not confronted with a terminal problem. Since 1904, moreover, the city has spent over $4,712,000 in building nine city piers and acquiring the necessary property. Of these, No. 4 is open and devoted wholly to smaller boats, No. 8 is open and used for lumber, and No. 6 is open to all vessels.

At intermediate points on the canal, such as Wilmington, Chester, Perth Amboy, South Amboy, etc., the matter of terminal facilities for general cargoes is of far less importance than at the larger terminals. Here the chief shippers and consignees with probable canal traffic are, for the most part, the owners of private wharves or have leased wharves which they are now using for water transportation.

While, therefore, the providing of water terminals is of prime importance to the proposed waterway, a large tonnage can be handled at wharves and piers used for the coastwise and inland business. To assure the success of the project, however, the cities should guarantee to provide sufficient wharfage facilities to accommodate all traffic that may seek the canal route.

VII. Development of Local Industries in New Jersey.

In addition to the through traffic of the proposed canal, a portion of its tonnage will depend upon the local industries along its route throughout New Jersey. These industries are dependent chiefly upon the abundant deposits of clay, sand, gravel, and the agricultural resources of that portion of the State through which the proposed route extends. They are already large and will develop further if the waterway is constructed.

The mineral resources adjacent to the canal route do not include any of New Jersey's stone deposits. A line drawn from Trenton across the narrowest part of the State separates the hilly section, which abounds in stone deposits, from the flatter coastal plain, in which rocks are either rare or wholly absent. They, however, include the most valuable clay deposits of New Jersey, which State is exceeded only by Ohio and Pennsylvania in the value of the clay products annually produced.

As is shown in the accompanying map,[1] there are two extensive beds of clay extending practically the entire length of the canal route from Raritan Bay to Philadelphia and beyond as far as Delaware City. One of these consists of clay marls suitable for brick; the other of Raritan sands and clays suitable for stoneware, fire clays, and brick. The total value of New Jersey brick and tile output in 1908 was $6,363,700 and $9,019,800 in 1907. The annual output of its pottery industries was valued at $5,949,900 in 1908 and at $6,985,600 in 1907. The total value of all its clay products in 1908 was $12,313,600 and $16,005,400 in 1907.

The clay products of Mercer County are valuable because they include the output of the pottery industry of Trenton. In 1908 sanitary ware, white ware, chinaware, porcelain electrical supplies, and other pottery products of Trenton were valued by the United States Geological Survey at $5,649,000, or nearly 95 per cent and 22.5 per cent, respectively, of the pottery output of New Jersey and the United States. Common brick are also produced on a large scale in the region around Trenton and Hightstown. Pressed brick are made at Trenton, as also are fire brick, drain tile, floor and wall tile. Drain tile is likewise made at Hightstown.

Middlesex County, also crossed by the proposed canal route, "is the most important clay-producing county in the State of New Jersey, and its importance was so marked, even at an early date, that in 1878 it was made the most prominent part of the Report on Clay issued by the New Jersey Geological Survey. Indeed, so extensively is the clay-working industry of Middlesex County developed that it is highly probable that the value of the clay products manufactured there, together with the value of the clay mined by persons other than manufacturers, forms about 35 per cent of the total value of the New Jersey clay-working industry." (New Jersey Geological Survey, "The Clays and Clay Industry of New Jersey," 1904.)

The clay products of the county include common, pressed, enameled and paving, hollow and fire brick, terra cotta, wall tiles, fireproofing, and conduits. It also ships much clay to other counties and States. Aside from a few outlying places, such as Jamesburg and Ten Mile Run, the Middlesex clay industries are mainly confined to the northeastern corner, at places such as Perth Amboy, South Amboy, South River, Sayreville, Keasbey, Maurer, Old Bridge, Woodbridge, and Sewaren. This is partly because the best and most available deposits are located there, but also because of the position of this region. "Many parts of the field are traversed by waterways, along which at many points large factories have been erected, and most of the clay pits are in close proximity to them as well, thus permitting easy shipment by water to many coastal points. The region is also crossed by several important lines of railroad." This same commercial advantage, due to position, would be extended to the clay deposits located farther west and south in Middlesex County were the proposed canal constructed.

The same clay formation found in Mercer and Middlesex Counties extends through Burlington County along the Delaware River. Common red brick are made in large quantities at Bordentown, Kinkora, Fieldsboro, Edgewater, and Maple Shade. Hollow brick are made at Crosswicks and Maple Shade; terra cotta at Burlington and Moorestown, and white-ware pottery at Bordentown. The construction of a deep channel from Philadelphia to Trenton as a part of the proposed waterway would also have an effect upon these clay industries of western Burlington County.

Throughout the counties adjacent to the proposed canal route there are, in addition to the clay beds, large deposits of sand and gravel. In the State as a whole they were worked to the extent of 2,124,000 tons in 1907, and 2,083,600 in 1908.

From 56,000 to 87,000 tons of glass sand were annually used in recent years. These deposits, however, are chiefly in southern Jersey, at points such as Maurice River, Vineland, and Williamstown, which are not reached by the proposed waterway. Though but small amounts are produced in the canal region, as at Old Bridge, the following statement of the State geologist of New Jersey as to the relation between bulky products, such as glass sand, and transportation facilities is pertinent: "On account of the bulky nature of the sand the cost of transportation is one of the leading items that determines the value of a pit, and consequently its life. This naturally confines the productive area of a glass-sand field to the vicinity of a railroad or navigable river. Practically every producing pit in southern New Jersey is less than 1 mile from a railroad or is along a navigable stream, although there is no doubt but that good undeveloped deposits of glass sand exist elsewhere in this region." (Annual Report, State Geologist of New Jersey, 1906.)

The proposed waterway further taps some of the best agricultural lands of New Jersey, large tracts of which are suitable for truck farming and fruit growing. As long ago as 1899 Burlington County had 20,900 acres devoted to vegetable growing, Mercer County 5,313, and Middlesex County 5,989. In its annual report of 1908–9 the State board of agriculture, through the local board of the county, reported that in Mercer

[1] Not printed.

County 1,800 acres are devoted to raising potatoes, producing 162,000 bushels annually, valued at $121,500. The value of miscellaneous vegetables and fruits is reported at $452,190; milk, $495,116; and poultry, eggs, etc., at $159,300. The total crop, including grains, is placed at $2,283,416. The president of the Mercer County Board of Agriculture states that "The southern part of the county is particularly adapted for the vegetable and truck business. The northern part of the county is well adapted for raising the larger fruits—apples, peaches, pears, cherries, etc.—while the southern part is well calculated for the small fruits."

Mercer County has a considerable market in Trenton, to which surrounding farmers cart their produce. It is probable, however, that the larger market which the proposed canal would make available would result in a rapid growth in their truck farming and fruit-growing industries. Middlesex County also raises considerable crops of potatoes, vegetables, and fruits, but all available soils are not utilized. In this, as well as in the northern part of Monmouth County, the proposed waterway would probably stimulate these industries by opening larger markets. Burlington County farmers are nearer to Philadelphia, but those within reach of the Delaware would likewise be affected by the deepening of the channel from Philadelphia to Trenton. A large manufacturer of canned goods in his statement to the committee writes: "The proposed canal would enable the farmer to get his products to Philadelphia or New York markets, thereby, allowing him to utilize his ground for the raising of fresh vegetables, a thing that is now impossible with present transportation facilities." The development of the farming industries of New Jersey is of importance not only to the farmers, but to the consumers, for the food supply is a growing problem to the dense population of the North Atlantic seaboard.

It is probable that the proposed waterway would have somewhat the same effect upon the development of local industries of New Jersey that some of the improved waterways of Europe have had upon those in their adjacent territories. The accompanying map graphically shows the industrial development of Germany along the canalized River Main from Frankfurt to Mainz. In 15 years existing industries were vastly expanded and many new ones, based upon the available resources and cheap transportation, were established. The British Royal Commission on Canals and Waterways found that the influence of this waterway and of others "had not been limited to single cases, but that numerous industrial establishments of all sorts had settled along or in the neighborhood of the waterways. The waterway has in many cases led to the utilization of mineral resources that would otherwise not have been exploited, for instance, the opening up of stone quarries, sand and gravel pits, and the erection of numerous brick yards, etc." The royal commission further notes the decentralizing influence of the waterways. In the case of the Main, "the new industries and the wage earners that they attract, have not settled around the city of Frankfurt, but along the river around less populated centers like Griesheim, Hoechst, etc." The findings of an official inquiry in Prussia likewise concluded that "in conjunction with the railways the navigable waterways exercise a special attraction on industries, and more so than the railways alone have done. Therefore, the waterways, on account of the qualities peculiar to them, appear to have a strong decentralizing influence."

VIII. Probable Shipments from Philadelphia, Wilmington, Chester, Trenton, Baltimore, Norfolk, Newport News, and other Points at Southern Terminus of the Proposed Canal.

The foregoing data relative to present shipments by water and rail, the extent of production in regions that will be affected and the large amount of cartage, supplemented by the testimony of numerous shippers, consignees, barge lines, and others interested in the shipment of freight indicate the nature and the large volume of the traffic upon which the canal will draw. Many of the leading commodities likely to seek the canal route have been considered. It has also been pointed out that new traffic would be created by the proposed waterway.

It will be well to consider the traffic by leading commodities. An admittedly heavy item of traffic to points near the eastern and western termini of the canal would be coal. Much of the coal now shipped by water from Philadelphia, Baltimore, Norfolk, and Newport News would probably take the canal route to destinations on the New England coast. Lumber, railroad ties, shingles, wood and wood pulp, and piling are a second heavy group, for even now large quantities are shipped by water from southern ports to New York, Boston, and other New England points. The building materials including brick, stone, gravel, sand, plaster, cement, lime and tile, constitute a third important group of commodities suitable to the proposed waterway. Certain quantities of iron and steel and structural iron are available. So, too, are cargoes of petroleum and its

products, pottery, Philadelphia and southern textiles, leather, tobacco, hardware, machinery and fertilizers. In addition, the South would probably contribute shipments of cotton, phosphates, fruits and vegetables, and naval stores.

The importance of general merchandise in the probable shipments to northern and eastern points it is impossible to estimate. This group of articles, however, includes the great variety of miscellaneous manufactures produced in cities along the western and southern portions of the waterway and its extensions, such as chemicals, electrical machinery, glass products, carpets, hats, cardboard, brass goods, silk mill products, canned goods, and scrap metals. They now move northward and eastward in very considerable quantities both by rail and steamship lines. The material saving afforded by an inland water route would stimulate the movement of this class of freight to northern and eastern markets.

This conclusion is upheld by the statements of shippers representing many industries. A large Philadelphia shipper via steamship lines writes that 50 per cent of his shipments would probably move through the proposed canal at a saving of 50 cents per ton. A large plaster manufacturer, who annually ships from 40,000 to 50,000 tons via the outside route, writes that perhaps 100 per cent would pass through the canal at a saving of 25 cents per ton, or from $10,000 to $12,000 per year, and that his shipments would perhaps increase by 20 per cent. A paint manufacturer of western New Jersey, who now ships about 2,080 tons annually by rail, estimates that 50 per cent would take the canal route, and that shipments would increase 100 per cent. A Philadelphia manufacturer of paper cardboard writes:

"Should the canal be put into practical operation we can conservatively say that our business with New York City, eastern New York State, covering such points as can be reached advantageously by Hudson River, and New England seaports would be increased from 300 per cent to 500 per cent. One of the principal things which prevents our doing business in the above-named territory is lack of shipping facilities to secure prompt deliveries at a minimum transportation charge."

A large New Jersey shipper of canned goods, ketchup, etc., with total present shipments of over 7,700 tons to the leading points adjacent to the canal, estimates that 75 per cent of this traffic would take the canal route at a saving of 80 cents per ton, or $4,672 annually.

A large Philadelphia coal company, which annually ships from 300,000 to 400,000 tons of coal to northern and eastern points via the outside route, writes that 90 per cent of this tonnage would probably take the canal route at a saving of from 10 to 15 cents per ton, or from $40,000 to $60,000 annually, and that its shipments would probably increase 100 per cent as a result of the proposed waterway. A heavy shipper of lime from the lower Delaware writes that about 50 per cent of his present shipments would go through the canal, and that "steam barges would probably increase it from 20,000 to 40,000 tons to New York Harbor. An advantage would be to deliver the material either up the Hudson or East River via barge without extra handling or lighterage charges as at present."

A Philadelphia lumber dealer writes: "If the canal between here and New York is enlarged and made free much of the lumber from the inland waters of Virginia and North Carolina will no longer be forced upon Washington, Baltimore, and Philadelphia, but will be sold to much better advantage because the market for it will be enlarged so greatly. The development of new business would immediately become possible."

Similar estimates of probable traffic have also been received from shippers and receivers of brick and tile, railroad ties, wood and wood pulp, shingles, piling, brass goods, glass bottles and jars, quartz, stoves, ranges, furnaces, and boilers, hardware and machinery, pottery, leather, cotton-mill products, agricultural products, iced fish, silk-mill products, dyewoods, metals, coke, iron pipe and foundry products, railroad cars knocked down and boxed for export via New York, boats for New York and beyond, granite, fertilizers, straw and straw goods, mill and feed products, tar and oil, and other articles at points ranging from Trenton to North Carolina points.

IX. Probable Shipments from New York Bay and New England Points.

Present shipments of bulky products from points on New York Bay and on the New England coast to canal points southward are less numerous than those moving in the opposite direction. There is, however, a considerable movement of pottery, brick, tile, and terra cotta, structural iron, slaughter-house refuse, manure, stone, salt, paper, and hides. A very considerable tonnage would be offered the proposed waterway by these commodities. Hides, for instance, are needed on a large scale at Wilmington, Del. At present many are collected at New York from Argentina and there transshipped by rail. It is believed that transshipments to Wilmington would be made by

water if an inland waterway were provided to make barges available at the side of the ocean-going steamships in New York Harbor.

The shipments of bulky products would be further swelled by the existing truck-farming industry adjacent to the route of the canal and that which is likely to be built up by the canal in the future.

It is further anticipated that certain quantities of Erie and Champlain Canal freight would be shipped southward through the proposed waterway. In 1906 the superintendent of public works of New York reported that in their present unimproved condition the canals of New York handled 3,540,000 tons of freight. 1,006,000 tons of this was through freight and 953,000 tons moved as far as New York City. The main items in the through business are grain, lumber, stone, lime, and clay, ice, iron ore and pig iron, and general merchandise. Upon the completion of the improvements now under way on the Erie Canal it is probable that greater amounts of grain will move eastward from Buffalo and that considerable quantities would reach Philadelphia in that way were the proposed New Jersey canal constructed. A prominent Philadelphia iron and steel manufacturer has predicted that the proposed canal would enable the iron interests of Delaware Bay to obtain iron ore by way of the Erie Canal direct from Lake Superior in competition with imported Cuban ore, to the benefit of the entire industry of this district. It is probable that considerable quantities of stone, ice, and salt would likewise move to Philadelphia and adjacent points from Erie Canal territory.

A large share of the present shipments from New York and New England points southward consist of package freight, including general merchandise and manufactures of many kinds. Some of this freight would doubtless move by way of the proposed canal both on barges and steamers. A study of the production of these classified products and their markets emphasizes the possibility of heavier shipments to coastwise points than are at present made. This is particularly true of clothing, boots and shoes, tobacco manufactures, flour, furniture, sugar, and molasses.

Certain quantities of freight, such as New Orleans molasses, rice, and other products, are at present received at Philadelphia and adjacent points by way of New York. It was pointed out to the committee that such freight could more easily and at less expense be transshipped to barges at New York if an inland waterway were provided to make them available. This difficulty, however, has been largely overcome by the establishment of a New Orleans service to Philadelphia.

Similar to these shipments from New Orleans is the large variety of merchandise imported at Philadelphia from foreign countries via New York, which is the center of many of the ocean steamship lines tapping foreign markets. A material saving would result if many of these "in-transit goods" were transshipped to barges instead of railroad cars from the seagoing steamships which carry them to New York Harbor.

The statements of a few typical shippers at the northern and eastern termini of the waterway may be pertinent. A Jersey City iron company writes that "If this intracoastal canal should be opened and established we could give them about 500 tons per year of freight. It would also open up sand and clay banks in the districts where this canal would be cut, and where it is too far to haul from now to the railroads. These veins of sand and clay are very valuable to this vicinity, and would be valuable to us, as we use considerable quantities of these materials." A large New York shipper of coal-tar products, now shipping 75,000 tons by water, estimates that 75 per cent would pass through the canal at a saving of 25 cents per ton, and that shipments would increase from 25 per cent to 50 per cent. A South Amboy shipper of terra-cotta and pottery clays estimates that he would ship 20,000 tons through the canal annually at a saving of 15 cents per ton, and that as a result his business would increase 50 per cent. A leather manufacturer of Newark writes: "The dredging of the Passaic River increased our tonnage 100 per cent by water. We feel that the canal would do the same."

The shipment of in-transit goods via New York is shown in part in the statement of a large Philadelphia manufacturer of woolen and silk goods and carpets: "It will enable us to get direct shipments from South America and Mediterranean ports. We use largely of wool from these points and could make through freights to this city. A million pounds of wool are now on the way, and we have had to await shipments for two weeks on part of this wool because there were no vessels to Philadelphia. We can always get them to New York, and if we had a ship canal could save from 5 to 7½ cents per 100 pounds."

X. Effect of Canal upon Railroad Traffic.

Viewed from another standpoint, the probable traffic of the proposed waterway will come from three sources: (1) The diversion of existing water traffic from the present outside and inland routes; (2) the diversion of railroad traffic; and (3) the creation of new canal traffic.

The first of these is singly of sufficient magnitude to warrant the construction of an inside route. The diversion of but a reasonable percentage of the present tonnage which passes between the ports of the north Atlantic by water would result in a large and growing canal traffic.

The second source is of less importance, though certain quantities chiefly of low-class freight would be diverted to the canal. A portion of the prospective shipments of Southern lumber, wood and wood pulp, railroad ties, fertilizers, stone, sand, brick, lime, terra cotta, gravel, agricultural products, heavy iron and steel products, now transported to some extent between these adjacent ports by rail, would doubtless be diverted. Many of these low-class articles, it should be remembered, are among the least profitable of railroad traffic. Their intrinsic value is so low that the rates which some of them are able to pay are not sufficient to cover the entire cost of handling them by rail. They are at times regarded as profitable traffic if they but yield a surplus over and above operating expenses; and their portion of the fixed charges of the railroad is shifted to articles of higher class which are able to bear higher rates.

In periods of prosperity, moreover, the railroads have shown their inability to handle all available traffic without serious delays. Even under present conditions, as was mentioned above, it is a common complaint among many shippers and consignees that rail shipments are subject to delays which make prompt deliveries impossible. Whatever diversion of heavy freight may result would enable the railroads more fully to develop their high-class traffic, which yields the highest relative profits.

The probable package freight tonnage of the proposed canal, above mentioned, would also result in the diversion of some high-class freight from rail carriers. Since such traffic, however, is essentially suited to rail transportation if conducted so as to assure prompt deliveries, the proposed waterway would be chiefly a complement to existing transportation facilities rather than an antagonist of rail lines. Various railways operate barges and coastwise steamers in connection with their rail lines, and to such of their water equipment as could use the proposed waterway it would be a direct advantage.

The third source, namely, the creation of new canal traffic, depends upon the probable expansion of existing industries and the rise of new industries at points adjacent to the canal. The amount of such traffic is problematical, but it is believed that a very considerable percentage of the canal's tonnage would be created in this way. Cheap transportation of the raw materials of industries almost inevitably leads to a growth in business. This would increase the traffic of the railways as well as of the waterway, for as the shipments of raw materials increase, so also grows the tonnage of finished products suitable for rail transportalion. A large shipper of coal, iron, ore, pig iron, steel billets, etc., made the following pertinent statement to the committee: "The history of the Erie Canal shows that the building and maintaining of an adequate canal tends to build up factory communities using coal, lumber, pig iron, etc., and turning out highly finished products—thus furnishing to the railroads an equal tonnage of finished stuff at a much higher class rate, so that the railroad profits largely by the change."

The statements of shippers, above mentioned, many of whom predict a material increase in their business if the canal were constructed, are especially significant in this regard. So, too, are the probable expansion of the truck farming and clay industries of New Jersey in the sections bordering on the canal. Other new industries may spring up at points adjacent to the canal as the result of the cheaper transportation of the necessary raw materials.

[Appendix 1.]

OPINIONS OF NAVAL AUTHORITIES UPON THE NAVAL VALUE OF THE PROPOSED CANAL.

[View of Rear Admiral C. S. Sperry, United States Navy.]

The inland waterways of the Atlantic coast are an important factor in the National defense in several ways. Not only do they afford a secure passage for certain vessels of the Navy, but the sounds, particularly, are an outer line of defense, the ditch of the fortress. Submarines, destroyers, and torpedo boats, secure in their smooth waters, and able to pass out through occasional passages, readily defended by mines, can drive off an enemy's fleet, and a hostile landing will be impossible.

Several times within the last 15 years torpedo boats drawing from 6½ to 7 feet, have made the inland passage from Key West to New York Bay, but with more or less difficulty in the region below Norfolk, and with some damage.

Torpedo boats are not large enough to take the sea and attack an enemy to the best advantage at a distance from the coast, and they have been superseded in the building program of the Navy Department by destroyers and submarines. In order that the largest destroyers and submarines built or contemplated may pass freely and safely

through the canals and passages, an ultimate depth of about 14 feet should be considered, and the radius at bends must be very considerable. The torpedo boats which made the inland passage found their greatest obstacle in the sharp bends, and the new destroyers are about 295 feet in length.

Destroyers and submarines, owing to the fatigue of their crews, and to the character of their motive power, can only reach their highest efficiency when operating from a secure and comfortable base, and it is evident that the conditions in this respect are ideal along the greater part of the Atlantic coast if the waterways are adequately improved. As you are aware, the Navy Department has established a complete chain of most efficient wireless stations from Maine to Texas, and the destroyers and patrol vessels being equipped with wireless, as well as the fleet, communication throughout the whole system will be practically instantaneous.

STRATEGIC VALUE OF INLAND WATERWAYS ALONG THE COAST LINE.

[Rear Admiral George W. Melville, United States Navy, former Chief of Bureau of Steam Engineering, Navy Department.]

I call particular attention, however, to the fact that this same internal route from Long Island Sound to the Capes of Virginia offers us an element of naval strategy whose value it would be very hard to overestimate. Just note that along this route we have the great navy yard at New York, the one at Philadelphia, the great ship yards on the Delaware, the manufacturing facilities of Baltimore, connection with the gun foundry at Washington, the great ship yards at Newport News, and the navy yard at Norfolk. To make this of real value for naval purposes, the depth must be adequate to permit the passage of battleships, which means a present depth of about 30 feet, and possibly at a later date 35 feet. At present, however, 30 feet would take care of our vessels of deepest draft.

If you will stop to remember one of the chief reasons advanced for the building of the Panama Canal by our country, you will see the strategic importance of this inland waterway. You all remember the feeling of anxiety throughout the country when the *Oregon* was on her long trip down the west coast of South America, through the Straits, and up the east coast, before she joined the rest of our fleet. The time necessary to make this circuit of South America is so great that for the adequate protection of both our coasts a large fleet is necessary. Experts in strategy tell us, however, that with the completion of the Panama Canal a much smaller aggregate number of ships will suffice for adequate defense, because vessels can be sent from one ocean to the other in a very short time, thereby enabling the Atlantic Fleet to be a real support to the one in the Pacific, and vice versa.

In the case of the inland waterway paralleling our east coast, something of the same sort is true also along somewhat different lines. Let us imagine that in Chesapeake Bay we have a fleet of say 16 powerful battleships, but just outside, waiting for them to come out, is a hostile fleet of perhaps 20 or 25 equally powerful battleships. At the same time there are perhaps at the League Island Navy Yard five or six battleships just fitting out. Possibly several others are just about being completed at the great shipyards on the Delaware. For these vessels to come out in small squadrons, in the attempt to concentrate, by the external route is to invite disaster, because the enemy's fleet is more powerful than either of the separate squadrons, and in these days every competent naval commander is familiar with Napolean's famous tactics of dividing the enemy, and beating him in detail. With the inland waterway it would be perfectly easy for the vessels from the Delaware to get down into the Chesapeake and join the other fleet, making it more powerful than the enemy. I will not attempt to elaborate this argument or to develop it more fully, as I am sure the suggestion which has just been given will enable you to think of numerous situations where a like benefit would be derived. Possibly it is not necessary to mention it, but I do not want you for a moment to think that the idea of providing this internal route is to make of the sand dunes or our Atlantic coast a refuge behind which our fleet is to hide. No one believes more firmly than I that the proper battle line for any navy is the coast line of the enemy, but it is to enable us to get the maximum advantage of our fleet that this scheme is advocated. We are all justly proud of our great naval victory at Santiago, but if any of you had an opportunity of meeting Admiral Cervera, the Spanish commander, and found what a fine man he was, you could not help a feeling of pity for him in his position at Santiago, bottled up, so that there was no exit, except into our fleet of superior strength, so that he knew perfectly well that when he came out on that Sunday morning in July it meant annihilation. Suppose that, instead of the one exit where the entire hostile fleet could be concentrated, there had been communication with a number of other bays, from either of which he might have got out, and you will see very thoroughly the tremendous advantage of this internal waterway from the naval standpoint.

I have not laid any stress upon the usefulness of this internal waterway for torpedo vessels and the smaller craft, which would not need such a deep channel, for the reason that while these are essential auxiliaries of a modern fleet, naval men all over the world are now thoroughly agreed that the real fleet consists of the battleships, which are able both to give heavy blows and withstand them. The experience of the last two wars—ours with Spain, and that of Russia against Japan—showed very conclusively that while there is a rôle for torpedo vessels, it is a very minor one when the battleship fleet is thoroughly disciplined and trained.

The opinions of Rear Admiral Jas. M. Forsyth, United States Navy, were expressed as follows in a letter written to Mr. Joel Cook, November 18, 1907:

SHAMOKIN, PA., *November 18, 1907.*

MY DEAR FRIEND: I am much gratified to see your name mentioned as one of the advocates of "coast waterways project." I hope to see you push hard for it, and so link your name with the success of an enterprise that means much to the future of the commerce of our Nation. It is truly national, and if perfected will be a benefit to the whole country. Nature has so prepared the way that there are really no great engineering difficulties to overcome, and the matter affects so many States and sections that there is the strongest reason that it should have financial aid from the General Government. Every cent that our Government spends to make communication between the sections easy is, in my opinion, wisely expended, tending to make us a homogeneous mass ready to work together. With a canal put across Florida, there is already a system of natural inland waterways along the Gulf coasts of Florida, Alabama, Mississippi, and Louisiana that can easily make New Orleans the terminus instead of Beaufort, N. C., and we can meet our brothers of the West as they come down the Mississippi with their project. This scheme for an inland waterway along the Atlantic coast has been the dream and desire of every seafaring man for 60 years; the Lord grant that I may live to see it fairly started for accomplishment. Do not try for too much at first; if you can get a 14-foot channel, I trust to the good common sense of the coming American to make it 20 or 25 in good time. The healthy competition of water-borne freight would take a lot of the bitterness out of the present feeling toward the monopoly of railroads, and that is what we want. To our Navy it would be a boon, enabling us, in time of war, to shift our torpedo boats and submarines from one port to another, and so keep the enemy guessing. I had one personal experience during the War of the Rebellion that will point the moral. I was a young officer on one of our ships, in the South Atlantic Blockading Squadron, when we were sent by the commander in chief with important dispatches from Port Royal, S. C., to Nassau Sound and Ogeechee Sound, Ga. They were to warn the blockading vessels there of an expected raid or attack on them from Savannah. We went out of Port Royal into a southeast gale, which became so bad that our small gunboat could not stand it, and we were forced to take refuge in Tybee Sound, the entrance to Savannah. Our captain was much worried, and finally, studying our charts, found that a light-draft boat could get through inside to Nassau and Ogeechee. I volunteered for the service, and in a 10-oared cutter, went through that inside passage, took the dispatches to their destination and returned safely to my ship. You see, there is where in their natural condition those inland waterways helped us; how much more they will do it when improved by the enterprise and intelligence of the present generation.

You are working for a meritorious enterprise, and you, as a business man and one who has always been in touch with the commercial interests of your community, can not fail to see the benefits that must accrue to the general public if you make it a success. I hope you will pardon my addressing you, but my heart is full of this matter, and I want to see it go through. All I have written is in the most friendly spirit to yourself, and I hope you will see it so.

Your old friend,

JAS. M. FORSYTH,
Rear Admiral, United States Navy.

COAST LINE INLAND WATERWAYS AND NATIONAL DEFENSE.

[Opinions of Capt. Richmond P. Hobson.—Extracts from an address of September 1, 1910, before the Third Annual Convention of the Atlantic Deeper Waterways Association.]

Advantages in time of peace.—In time of peace the advantages of inland waterways in national defense means a larger establishment and larger return for given outlay of national treasure.

The development of our coastwise inland waterways would contribute materially to lower the cost of construction and of maintenance of our principal coast fortifications, navy yards, and naval stations. The saving would be greatest for the estab-

lishments distant from the sources of supply of materials, which include the great plants of the New York and New England groups.

To illustrate how great the saving would be, it is sufficient to cite the large quantities of heavy materials constantly required by the Government on which the transportation charges would be more than cut in half, such as guns, armor, fuel, ammunition, machinery, structural steel, cement, and other heavy materials used in the construction, repair, or equipment of forts, naval stations, and ships.

The cheaper transportation would stimulate our commercial establishments to compete in supplying war materials for the world's markets, and the enlargement of these establishments would be a great asset in national defense. In addition, the inland waterways would enable our frail vessels to escape the rigors of the sea in being transferred from one station to another.

At the present time the bulk of the above advantages for existing establishments would be realized through inland waterways extending from Norfolk to Boston. It should be pointed out, however, that the opening of the Panama Canal will make the Carribean Sea and Gulf of Mexico the center of distribution of the world. The development of the iron and coal fields of Alabama on a river already navigable to tide water will not only create new establishments for building ships and manufacturing war materials on the Gulf, but will make a new source of supply of structural materials for the older establishments on the Atlantic proper. Furthermore, the Mississippi River will pour a great commerce into the Gulf on its way to the Pacific and to the markets of the world. Therefore the plan for the development of our inland waterways should carry improvements on all the systems at the same time.

Advantages in time of war.—As great as would be the advantages of our inland waterways in years of peace, their greatest advantages would come in time of war.

The wonderful development of transportation in recent years has brought every important nation within striking distance of all other nations, and at the same time has multiplied the magnitude and swiftness of war operations, so that modern wars have become substantially a test of the military preparations of the belligerents, and not of their resources. All of these developments have worked to the disadvantage of America. All other nations have leaped to arms, have organized their whole population into armies, and have taxed their finances upon their fleets, policies that weaken their resources, but increase enormously their preparations.

America alone has failed to organize her people into armies and has given but scant thought to her Navy. Though our resources are relatively boundless, our preparations are woefully inferior, and a short war, testing only preparations, would leave us in humiliation and defeat. Therefore our main objective in an important war must be to gain time and bring our resources into play. The enemy's objective on the contrary will be to strike a staggering blow at once before our resources are brought to bear, seize our commercial centers, destroy our navy yards and shipyards and bring us to terms quickly. If we bring our resources to bear we win; if we fail, we lose the war.

Whether we succeed in gaining our main objective will depend more upon our inland waterways than upon any other factor.

Conclusions.—The conclusions to draw from even this very incomplete examination are simple and clear.

1. That our coastwise inland waterways next to our fleet itself can be made the most vital factor of national defense.

2. That the services of these waterways increase with the nation's peril. They are useful for economy and for building up plants in time of peace; they would always be a source of strength after the national defenses were well provided for. They are now of paramount importance under our present woefully inferior conditions of defense.

3. That in any war under present conditions they would afford our only chance of gaining the time necessary to organize our forces and bring to bear our great resources. They would furnish the only refuge for our inferior fleet, in the face of overwhelming odds without permitting its blockade; they would make it possible for our fleet, though inferior, to give battle after choosing its own time and conditions, and enable it to retire if necessary; they would make it possible to utilize and expand all our establishments for repairing and building ships and to assemble and concentrate ships as fast as ready.

4. That upon our coastwise inland waterways in their relation to the fleet will largely depend the security of our navy yards, shipyards, and coast cities, and our chance of escaping the knockout blow that will surely be leveled across our poor defenses the instant war is declared.

Summing up, if there were no commercial value to our coastwise inland waterways, their paramount vital importance in national defense would warrant and demand immediate measures on the part of Congress to bring about their full and speedy development.

[Appendix "2."]

The following list of wrecks occurring on the Atlantic and Gulf coasts during the years 1906 to 1910, inclusive, includes only those involving total loss. It consequently does not correspond with Table XXVI, which includes all vessels damaged as well as lost. The vessels named in this appendix, moreover, include many ships wrecked outside of the zone of the proposed canal's influence. It is submitted, not to show that an intracoastal canal would have prevented all the losses reported, but to give a specific proof of the great dangers to navigation along the Atlantic and Gulf coasts. It is compiled from the annual reports of the United States Commissioner of Navigation.

List of vessels lost.

[Taken from reports of United States Commissioner of Navigation.]

Name of vessel.	Rig.	Lives lost.	Nature.	Date.	Place.
Alice	Schooner		Stranded	May 7, 1906	Chincoteague Cove, Va.
C. C. Lane	do		do	Mar. 19, 1906	Boston, Mass.
Charles A. Witler	do		Collision with schooner John Bossert.	Aug. 26, 1905	Diamond Shoals, N. C.
D. Gifford	do		Stranded	Apr. 10, 1906	Field Rocks, Mass.
Emma L. Cottingham	do	5	Foundered	June 10, 1906	Lat. 26° 58′ N., long. 58° 10′ W.
Gertrude L. Trundy	do		Abandoned	Sept. 4, 1905	Off Thatchers Island, Me.
Hamilton Fish	do		Foundered	Mar. 6, 1906	Off Barnegat, N. J.
Hattie G Dixon	Barkentine		Stranded	May 13, 1906	Chappaquiddick Island Mass.
Ira D. Sturgis	Schooner		do	Feb. 15, 1906	Near Indian River, Del.
Jennie Sweeney	do		Foundered	June 14, 1906	Cape Fear Bar, N. C.
Jennie Lockwood	do		Stranded	Feb. 13, 1906	Pea Island, N. C.
Jesse W. Starr	do	6	Abandoned	Feb. 27, 1906	Lat. 37° 33′ N., long. 74° 36′ W.
John R. Bergen	do		do	Mar. 1, 1906	Lat. 36° 12′ N., long. 72° 30′ W.
John S. Deering	do		do	Mar. 5, 1906	Lat. 37° 5′ N., long. 71° 50′ W.
Lizzie Chadwick	do		do	Mar. 6, 1906	Off Cape Hatteras, N. C.
Martha E. McCabe	do		Foundered	Mar. 20, 1906	Barnegat, N. J.
Mary Manning	do		Abandoned	Mar. 4, 1906	Lat. 39° N., long. 68° W.
Nettie Cushing	do		Stranded	Apr. 13, 1906	Cornfield Sand Shoal.
Norumbega	do		Collision with schooner Edith L. Allen.	Apr. 23, 1906	Fenwick Island, Md.
Pendleton Sisters	do	1	Stranded	Dec. 15, 1905	Chincoteague, Va.
Raymond T. Maull	do		do	Mar. 21, 1906	Gull Shoal, N. C.
Robert H. Stevenson	do	12	do	Jan. 13, 1906	Diamond Shoals, N. C.
Samuel L. Russell	do	5	Foundered	Jan. 8, 1906	Chesapeake Bay.
Santiago	do		Collision with S. S Philadelphia.	Dec. 3, 1906	Off Delaware Breakwater.
Thomas A. Goddard	do		Stranded	Dec. 2, 1905	Nags Head, N. C.
Van Name & King	do	6	Foundered	Oct. 6, 1905	At sea.
W. H. Van Name	do		Struck submerged barge Oak.	Mar. 31, 1906	Hampton Roads, Va.
Wm. F. Campbell	do		Foundered	Apr. 28, 1906	Off Owlshead, Me.
Wm. H. Archer	do	4	do	Sept. 14, 1904	En route Bangor, Me., to Vineyard Haven.
Peconic	Steamer	20	do	Aug. 28, 1905	Off Fernandina, Fla.
A. Heaton	Schooner		Stranded	Jan. 24, 1907	Outer Brewster Island.
A. P. Emerson	do		Foundered	Dec. 3, 1906	Off Cape Sable, N. S.
Adam W. Spies	do		Stranded	Dec. 1, 1906	40 miles west of Stirrup Key.
Annie L. Henderson	do		Burned	Sept. 1, 1906	Bangor, Me.
Arthur C. Wade	do		Stranded	Mar. 26, 1907	St. Helena Shoals.
Asa T. Stowell	do	7	Foundered	Sept 22, 1906	From Pensacola, Fla.
Bala	do	3	do	Feb. 5, 1907	Off Atlantic City, N. J.
Bonny Doon	Barkentine		Stranded	Dec. 6, 1906	Stone Horse Shoal, Mass.
C. P. Dixon	Schooner	8	Foundered	Aug. 30, 1906	From Philadelphia.
Casper Heft	do		Stranded	Dec. 24, 1906	Smiths Point, Va.
Cassie F. Bronson	do		do	Sept. 17, 1906	Near Cape Fear, N. C.
Charles Loring	Bark		Collided with S. S. Seneca.	Feb. 2, 1907	Off Sandy Hook, N. J.
Charles F. Tuttle	Schooner		Abandoned	Sept. 17, 1906	Charleston, S. C.
Charles L. Mitchell	do		do	Dec. 8, 1906	Off Cape Henry, Va.

List of vessels lost—Continued.

Name of vessel.	Rig.	Lives lost.	Nature.	Date.	Place.
Chauncey E. Burk	Schooner		Stranded	Sept 6, 1906	Sandy Point, Abaco.
Darby	do		Foundered	Feb. 5, 1907	Off Atlantic City, N. J.
Ella G. Eells	do	4	Stranded	July 4, 1906	Libby Island, Me.
Everett Webster	do		Abandoned	Apr. 12, 1907	Off Cape Hatteras.
Fannie Reiche	do		Collided with schooner Martha E. Wallace.	Dec. 23, 1907	Off Winter Quarter Light, Va.
Florence I. Lockwood	do		Stranded	Dec. 6, 1906	Chincoteague Inlet, Va.
Fluorine	Bark		do	Sept. 27, 1906	Cat Island, Miss.
Fred. P. Litchfield	Schooner		Foundered	Sept. 26, 1906	Gulf of Mexico, Lat. 26° N., Lon. 87° 50′ W.
George V. Jordan	do		Stranded	Aug. 6, 1906	Pollock Rip Shoals, Mass.
Gertrude A. Bartlett	do		Abandoned	Sept. 27, 1906	Lat. 29° 15′ N., Long. 71° 45′ W.
Harry Knowlton	do		Collided with St. P. Larchmont.	Feb. 11, 1907	Off Watch Hill, R. I.
Helen J. Seitz	do		Stranded	Feb. 9, 1907	Beach Haven, N. J.
Helen M. Atwood	do		do	Feb. 18, 1907	Arenas Bank, P. R.
Henry Sutton	do	7	Foundered	Oct. 18, 1906	From Cheverie, N. S.
Horace G. Morse	do	2	Stranded	Jan. 19, 1907	Bliss Island, N. B.
J. F. Whitcomb	do		do	Mar. 24, 1907	Assateague Beach, Va.
James D. Dewell	do	7	Foundered	Sept. 17, 1906	Off Charleston, S. C.
James M. Hall	do		Stranded	Nov. 15, 1906	Long Beach, N. J.
Jennie Hulbert	Brig		Abandoned, towed into Port Eads, La.	Sept. 21, 1906	Gulf of Mexico, Oct. 10, 1906.
Jennie G. Pillsbury	Schooner		Stranded	Nov. 27, 1906	Two-Bush Reef, Penobscot Bay, Me.
John C. Gregory	do		Collided with S.S. Ontario.	May 4, 1905	Off Gayhead, Mass.
Landseer	do		Foundered	Mar. 13, 1907	Off Absecon, N. J.
Luis G. Rabel	do		Stranded	Nov. 18, 1906	Bulls Island, S. C.
Marshall Perrin	do	2	do	Nov. 16, 1907	Wood Island, Me.
Matilda D. Borda	do		do	July 16, 1906	Gull Shoals, N. C.
Merom	do		do	Oct. 13, 1906	Bonaire, D. W. I.
Nelson E. Newbury	do	6	Foundered	Sept 17, 1906	Off Charleston, S. C.
Oliver S. Barrett	do	8	Capsized; sailed from Port Royal for New York.	Sept. 9, 1906	At sea.
P. T. Barnum	do		Abandoned	Sept. 19, 1906	30 miles east of Bodie Island.
Pactolus	do		Foundered	June 2, 1907	Off Hog Island, Va.
Providence	do		Abandoned	Dec. 3, 1906	Lat. 34° 6′ N., long. 74° 47′ W.
R. D. Bibber	do		Stranded	July 17, 1906	Frying Pan Shoals, N. C.
Samuel H. Sharp	do		do	Jan. 25, 1907	Cape May, N. J.
Tena A. Cotton	do		do	Feb. 4, 1907	Ocean City, Md.
Twilight	do	6	Capsized	Sept. 16, 1906	50 miles off Charleston.
William Marshall	do		Stranded	Dec. 8, 1906	Highland Light, Cape Cod.
William D. Becker	do		Foundered	Apr. 7, 1907	Off Barnegat, N. J.
William H. Bailey	do		Abandoned	Mar. 8, 1907	Off Cape Hatteras, N. C.
Addie Morrill	Barkentine		Foundered	Oct. 3, 1907	Cape Hatteras, N. C.
Adolph Obrig	Bark	18	do	Apr. 10, 1907	Sailed from New York for San Francisco. Not reported.
Alcaea	Brigantine	7	do	Dec. 16, 1907	Sailed from Philadelphia for Martinique. Not reported.
Baltimore	Bark	9	do	Jan. 22, 1908	Sailed from Hampton Roads for Savannah.
Cumberland	Schooner		do	Sept. 24, 1907	Wolf Point, N. B.
David Carrie	do		do	Dec. 20, 1907	Duck Island, Conn.
E. M. Duffield	do		do	Jan. 1, 1908	Bridgeport, Conn.
Edmund Phinney	Bark		Stranded	Dec. 14, 1907	Sandy Hook, N. J.
Edward J. Berwind	Schooner		Abandoned	Jan. 30, 1908	Lat. 35° 24′ N., long. 71° 58′ W.
Emilie E. Birdsall	do	3	Collision with S. S. Jefferson.	Feb. 4, 1908	Winter Quarter Shoal, Va.
Estelle Phinney	do	1	Collided with schooner Elizabeth Palmer.	Dec. 27, 1907	Barnegat, N. J.
Fall River	do		Foundered	Jan. 25, 1908	40 miles southwest of Block Island.

List of vessels lost—Continued.

Name of vessel.	Rig.	Lives lost.	Nature.	Date.	Place.
Gardiner B. Reynolds	Schooner		Foundered	Dec. 5, 1907	Lat. 36° 17′ N., long. 78° 17′ W.
Geo. R. Vreeland	do	7	do	Jan. 27, 1908	Sailed from Hampton Roads for New York. No report.
H. E. Thompson	do		Stranded	Apr. 8, 1908	Anegada Island, W. I.
H. G. Johnson	Bark		do	Apr. 14, 1908	Cumberland Bar, Ga.
Havilah	Barge		do	Nov. 29, 1907	Point Garnas, P. R.
Helen E. Taft	Schooner		Collided with Swedish S. S. Uppland.	Jan. 29, 1908	Cape Lookout, N. C.
Helen G. Moseley	do		Abandoned	Jan. 26, 1908	20 miles east of Cape Henry.
Henry A. Litchfield	do		Burned	Aug. 12, 1907	Cape Henry, Va
Howard B. Peck	do		Stranded	Feb. 15, 1908	Fire Island, N. Y.
Jesse Barlow	do		Collided with S. S. Lehigh.	Dec. 17, 1907	Pollock Rip, Mass.
John E. Deevlin	do		Stranded	Jan. 10, 1908	Metomkin, Va.
Jonathan Sawyer	do		do	Nov. 6, 1907	Cape Porpoise, Me.
Josephone Ellicott	do	7	Foundered	Jan. 9, 1908	Sailed from New York for Mayport, Fla.
Leonora	do	5	Stranded	Jan. 8, 1908	Diamond Shoals, Cape Hatteras, N. C.
Mary L. Newhall	do		Foundered	Jan. 14, 1908	200 miles north of Bermuda.
Matanzas	do		Stranded	Jan. 27, 1908	Montauk, L. I., N. Y.
Melrose	do		do	Feb. 15, 1908	Cape Hatteras, N. C.
Mollie S. Look	do		do	Feb. 13, 1908	Hillsboro Inlet, N. C.
New York	do		Foundered	Oct. 23, 1907	15 miles southwest of Montauk Point, Long Island.
Nimbus	do		do	Dec. 15, 1907	Lat. 33° 15′ N., long. 74° 50′ W.
Number Twenty-six	do		do	Nov. 25, 1907	Barnegat, N. J.
Orient	do		Stranded	Apr. 18, 1908	Cape Lookout, N. C.
Pardon G. Thomson	do		do	July 26, 1907	Grand Manan Island, N. B.
Rebecca Shepherd	do		do	Dec. 4, 1907	Pollock Rip Shoal, Mass.
Rose Innes	Barkentine		do	Oct. 30, 1907	St. Simons Island, Ga.
S. S. Hudson	Schooner		Burned	Aug. 29, 1907	Southeast of Little Hope, N. S.
Charlton Henry	do		Collided with British S. S. Chelston.	June 23, 1907	Fire Island, N. Y.
Thomas A. Ward	do		Burned	Dec. 6, 1907	Lat. 32° 5′ N., long. 77° 48′ W.
White Band	do	6	Foundered	Jan. 24, 1908	Cape Henlopen, Del.
Wm. H. Skinner	do		Abandoned	Feb. 15, 1908	45 miles east-northeast of Frying Pan Shoals, N. C.
William L. Walker	do		Foundered	Oct. 29, 1907	40 miles south of Cape Lookout.
Bluefields	Steamer	18	do	Jan. 4, 1908	Cape Hatteras, N. C.
City of Birmingham	do		do	Nov. 4, 1907	Castle Island, Boston Bay, Mass.
Adeline Townsend	Schooner	6	Collision	Jan. 12, 1909	Cape Henlopen, Del.
Alice T. Bordman	do	1	Stranded	Jan. 4, 1907	Handkerchief Shoal, Mass.
Arleville H. Peary	do		do	Oct. 31, 1908	False Cape, Va.
Auburndale	do	10	Foundered	July 24, 1908	Sailed from Turks Island for Philadelphia. Not reported.
Belle O'Neill	do		do	Feb. 4, 1909	Cape Lookout Shoals, N. C.
Benj. C. Firth	do		do	June 28, 1909	Martins Industry Shoal, N. C.
Beulah McCabe	do	7	do	Sept. 15, 1908	Bahama Islands.
Charley Woolsey	do		Collided	July 25, 1908	Cornfield Light, Conn.
Dessoug	do		Foundered	Oct. 21, 1908	17 miles northeast of Winter Qarter Shoal, Va.
Elvira Ball	do		Abandoned	Feb. 8, 1909	130 miles east of Cape Charles, Va.
Eugenia A. Eley	Sloop	2	Capsized	Jan. 6, 1909	Chesapeake Bay.
Flora Rogers	Schooner		Stranded	Oct. 23, 1908	Boyds Island, N. C.
Florence Shay	do	2	do	Nov. 12, 1908	Virginia Beach, Va.
Gilberton	do		Foundered	Sept. 16, 1908	Brown Shoal, Del.
Harry Messer	do		Stranded	Dec. 24, 1908	Handkerchief Shoal, Mass.
Hattie M. Graham	do		do	June 15, 1909	Bouline, Cape Breton.

List of vessels lost—Continued.

Name of vessel.	Rig.	Lives lost.	Nature.	Date.	Place.
Henry Clauson, jr	Schooner		Abandoned	Nov. 6, 1908	En route Gulfport, Miss., to Michaels, Azores.
Henry Wolcott	do		Foundered	Aug. 20, 1908	Brooklyn, N. Y.
Horace P. Shares	do		Abandoned	Feb. 1, 1909	Lat. 35° 32′ N., long. 73° 48′ W.
Horace W. Macomber	do		Stranded	Nov. 24, 1908	Moselle Shoal, Abaca, Bahamas.
Howard Compton	do		Abandoned	Nov. 6, 1908	Lat. 35° 38′ N., long. 73° 40′ W.
Independent	do	5	Foundered	Nov. 14, 1908	Hog Island, Va.
Jeanie Lippitt	do	7	Stranded	Dec. 22, 1908	Winter Quarter Shoal.
Jennie Thomas	do		Abandoned	Nov. 16, 1908	300 miles east of Sandy Hook.
Jennie French Potter	do		Stranded	May 18, 1909	Vineyard Sound, Mass.
John McDermott	Brig	7	Foundered	Sept. 5, 1908	Sailed from New York for Fajardo, P. R. No report.
John A. Matheson	Schooner		Abandoned	Sept. 15, 1908	Lat. 26° 26′ N., long. 70° 5′ W.
John M. Brown	do		Foundered	Oct. 30, 1908	Lat. 37° N., long. 71° W.
Jose Olaverri	do		Stranded	July 23, 1908	Bull Island, S. C.
Joseph B. Thomas	do		do	Mar. 21, 1909	Fowey Rocks, Fla.
Julia Baker	do		do	Feb. 1, 1908	Millbridge, Me.
Lulie L. Pollard	do		Burned	Oct. 31, 1908	Lat. 35° 30′ N., long. 74° 10′ W.
Marie F. Cummins	do		Stranded	Nov. 14, 1908	12 miles south of Delaware Breakwater, Del.
Mary Sanford	do		Abandoned	Jan. 31, 1909	Lat. 38° N., long. 65° W.
Mary B. Judge	do	1	do	Sept. 14, 1908	Lat. 26° 18′ N., long. 71° W.
Miles M. Merry	do		Stranded	Feb. 17, 1909	Moriches, N. Y.
Myra W. Spear	do	3	Foundered	Dec. 28, 1908	20 miles west of Highland Light.
L. R. D. Spear	do		do	Nov. 3, 1908	250 miles north of Bermuda.
Rebecca W. Huddell	do		Stranded	Apr. 22, 1909	East Liberty Island, Me.
Sarrah W. Lawrence	do		do	Feb. 10, 1909	Cape Henlopen, Del.
Shawmut	Barkentine		do	Dec. 1, 1908	Yellowhead Island.
William Neely	Schooner	8	Foundered	Dec. 20, 1908	Carteret, N. J., for Savannah. No report.
Wm. C. Carnegie	do		Stranded	May 1, 1909	Moriches, N. Y.
Wm. C. Tanner	do	10	Foundered	Dec. 25, 1909	Rockport, Mass., for Key West, Fla.
Wm. H. Conner	do		Collided with Schooner Hugh Kelly.	Apr. 22, 1909	Sandy Hook, N. J.
Wm. J. Lormond	do		Foundered	Dec. 22, 1908	Currituck Beach, N. C.
Abel C. Buckley	do		Abandoned	Jan. 1, 1910	Lat. 35° 43′ N., long. 59° 42′ W.
Alice E. Clark	do		Stranded	July 1, 1909	Long Island Ledge, Penobscot Bay, Me.
Anna R. Bishop	do		Foundered	Dec. 25, 1909	Jacksonville for Elizabethport, N. J.
Arlington	do		Stranded	Aug. 17, 1909	Long Beach.
Auburn	do	9	Foundered	Dec. 23, 1909	Jacksonville for Philadelphia.
Asbury Fountain	do		Wrecked	Mar. 3, 1910	Winter Quarter Shoals.
Anna R. Bishop	do		Abandoned	July 19, 1910	At sea, 50° N., 24° W.
Ada Ames	do		Sunk	Aug. 30, 1910	Off Chatham.
Abbie G. Cole	do		Wrecked	Dec. 16, 1910	Boston Bay, Mass.
Ben Franklin	Sloop		Stranded	Nov. 9, 1909	Sandwich, Mass.
Bristol	Barge		Sunk	Sept. 4, 1910	Off Sandy Hook, N. J.
Belle Halladay	Schooner		Sunk, collision	Dec. 14, 1910	Near Vineyard Haven.
Charles J. Willard	do		Struck wreck	Sept. 18, 1909	Vineyard Sound, Mass.
City of Montreal	do		Stranded	Nov. 27, 1909	Plymouth Bay, Mass.
Carrie A. Norton	do		Wrecked	Feb. 6, 1910	False Cape, Va.
Catherine M. Monahan	do		Abandoned	Aug. 24, 1910	Cape Hatteras.
Cox and Green	do		Foundered	Nov. —, 1910	Lat. 39° N., long. 59° W.
Davis Palmer	do	14	do	Dec. 26, 1909	Boston Harbor.
Doris	Barge		Sunk	Feb. 28, 1910	Providence.
Edgar C. Ross	Schooner		Abandoned	Jan. 13, 1910	Lat. 40° 54′ N., long. 52° 51′ W.
Eleazer W. Clark	do		Stranded	Nov. 16, 1909	Frying Pan Shoals, N.C.
Eugene Borda	do		Abandoned	Dec. 2, 1909	Lat. 40° 20′ N., long. 68° 34′ W.
Edith Olcott	do		do	Aug. 19, 1910	At sea, 37° N., 65° W.
Edward T. Stotesbury	do		Wrecked	Oct. 20, 1910	Florida Keys.
Emily Baxter	do		do	Nov 25, 1910	Fire Island.
Frances	do	8	Stranded	Feb. 1, 1910	Cape Hatteras, N. C.

List of vessels lost—Continued.

Name of vessel.	Rig.	Lives lost.	Nature.	Date.	Place.
Florence Leland	Schooner		Abandoned	Oct. 16, 1910	Lat. 40° N., long. 64° W.
Frank T. Stinson	do		Burned	Nov. 30, 1910	At Porto Rico.
Gatherer	do		Foundered	Nov. 29, 1909	Assateague, Va.
George Taulane, Jr	do	7	do	Sept. 18, 1909	Belfast, Ga., for Philadelphia.
George A. McFadden	do		Stranded	Jan. 27, 1910	Diamond Shoals, N. C.
Geo. F. Phillips	do		Abandoned	Feb. 5, 1910	Lat. 33° 25′ N., long. 73° 40′ W.
Georgie L. Drake	do		do	Dec. 31, 1909	Lat. 35° 5′ N., long. 71° 47′ W.
Good News	Barkentine		do	June 3, 1910	Lat. 29° 42′ N., long. 74° 26′ W.
Governor Ames	Schooner	11	Stranded	Dec. 13, 1909	Wimble Shoals, N. C.
Gracie D. Buchanan	do		Wrecked	Feb. 11, 1910	Near Jacksonville.
George Churchman	do		do	Apr. —, 1910	Parreboro.
Geo. E. Prescott	do		do	Feb. —, 1910	Near Gloucester.
Henry B. Fiske	do	8	Stranded	Dec. 23, 1910	Nantucket, Mass.
Harry C. Shepherd	do		Sunk	Jan. 10, 1910	Near Cape Cod.
Henry L. Peckhan	do		Burned	June 29, 1910	Richmond, Me.
Harry K. Fooks	do	5	Abandoned	Oct. —, 1910	Gulf of Mexico.
Harry T. Hayward	do	3	Wrecked	Oct. —, 1910	Bahamas.
Hazel Dell	do		Sunk	Dec. 9, 1910	Off Rockport.
J. S. Hoskins	do		Abandoned	Feb. 8, 1910	Lat. 31° 32′ N., long. 69° 30′ W.
J. Henry Edmunds	do		Collided with S. S. Wm. H. Taylor.	Feb. 1, 1910	Sandy Hook, N. J.
James Boyce	do		Stranded	Oct. 10, 1910	Mussel Ridge Channel, Me.
Jennie N. Huddell	do		do	Feb. 4, 1910	Carters Shoal, Chincoteague, Va.
John Proctor	do		do	Sept. 13, 1909	Cape Henlopen, Del.
John A. Briggs	do	6	Foundered	Dec. 26, 1909	Off Barnegat, N. J.
Julia P. Cole	do		do	Jan. 21, 1910	Off Hatteras.
John Cadwallader	do		Wrecked	Nov. 22, 1910	Near Portland, Me.
Baroness	Barge		Sunk, collision	Nov. 15, 1910	Fire Island.
Lucy E. Friend	Schooner		Abandoned	Nov. 14, 1910	Winter Quarter.
L. O. C. Wishart	do		Wrecked	Dec. 5, 1910	Little Egg Harbor.
Maggie S. Hart	do	8	Foundered	Dec. 18, 1909	Jacksonville for New York.
Marie Palmer	do		Stranded	Dec. 17, 1909	Frying Pan Shoals, N. C.
Martha S. Bennett	do	7	Foundered	Dec. 16, 1909	Jacksonville for New York.
Merrill C. Hart	do	5	Collided with brig. bark. John S. Bennett.	Nov. 7, 1909	Off Block Island, R. I.
Mertie B. Crowley	do		Stranded	Jan. 23, 1910	Wasque Shoal, Nantucket Sound, Mass.
M. L. Wetherill	do		Wrecked	Jan. 13, 1910	Near Newburyport.
Mary J. Russell	do		Abandoned	Feb. 3, 1910	Lat. 29° N., long. 73° W.
Maud Seward	do		Wrecked	Jan. —, 1910	Tilsbury, Mass.
Marcus Edwards	do	5	Missing		
Maywood	Barge		Sunk	Dec. 16, 1910	Off Cape Cod.
Martha E. Wallace	Schooner		Wrecked	Dec. 21, 1910	Coast North Carolina.
Mollie Rhodes	do	5	do	Dec. 15, 1910	Off Chatham.
Nantasket	do		Stranded	Dec. 25, 1909	Scituate, Mass.
Nettie Champion	do		Abandoned	Dec. 27, 1909	Lat. 38° N., long. 70° W.
Nettie B. Dobbin	do		do	Apr. 28, 1910	Off Nantucket, Mass.
Norombega	do		Collided	June 16, 1910	Off Fire Island.
Nat Ayer	do		Wrecked	Oct. 21, 1910	Boston Bay.
Perkasie	do		Foundered	July 8, 1909	Off Barnegat, N. J.
Robert C. McQuillen	do	7	do	Dec. 19, 1909	Mystic, Conn., for Charleston.
Rosa Mueller	do		Burned	July 29, 1909	Brewer, Me.
S. M. Bird	do		Stranded	Jan. 10, 1910	Pollock Rip Slue, Mass.
Shawmont	do	5	Foundered	Aug. 17, 1909	Off Shinnecock, N. Y.
Shenandoah	do		Collided	Oct. 29, 1909	Nantucket Sound, Mass.
Sunbury	Barge		Sunk	Aug. 18, 1910	Off Cape Henlopen.
Scranton	do		do	Dec. 18, 1910	Off Cape Cod.
Theresa Wolf	Schooner		Foundered	Oct. 16, 1909	15 miles southwest Seguin, Me.
Thomas G. Smith	do		Stranded	Apr. 10, 1910	Core Bank, N. C.
Thomas B. Garland	do		Wrecked	Dec. 16, 1910	Nantucket.
West Virginia	do		Foundered	Sept. 29, 1909	Pollock Rip Slue, Mass.
Wm. P. Palmer	do		Wrecked	Sept. 30, 1910	Near Vineyard Haven.
William W. Converse	do	3	do	Oct. 20, 1910	Florida coast.
Wm. E. Bowen, jr	do		Sunk, collision	Nov. 30, 1910	Off Bermuda.
Wm. H. Davidson	do		Wrecked	Dec. 12, 1910	Coast North Carolina.
Young Brothers	do		Burned	June 29, 1910	Richmond, Me.

[Appendix 3.]

ESTIMATED REDUCTION IN FREIGHT RATES RESULTING FROM PROPOSED CANAL.

PHILADELPHIA, *March 7, 1911.*

Mr. WILFRED H. SCHOFF,
Care of Commercial Museum, Philadelphia.

DEAR MR. SCHOFF: Referring to your esteemed favor of February 6, 1911, relating particularly to a comparison or estimate of the freight charge on transportation of merchandise between New York and Philadelphia over three mediums, namely, first, by rail; second, by Delaware & Raritan Canal, as at present operated; and third, by modern barges of large capacity, such as could be operated through a free public waterway of the sort planned in Col. Black's survey.

From data which we have compiled and from discussions of the general subject with numerous experts and practical men, we are satisfied that merchandise of the classes and descriptions generally moving or likely to move between Philadelphia and New York (this excludes packages of exceptionally heavy weight and extra hazardous character of merchandise) should be handled through the free ship canal in barges at a freight transportation rate of not exceeding, respectively, 35 and 45 cents per ton of 2,000 pounds. We believe that with modern, up-to-date facilities for handling the merchandise into and out of the barges, same could be performed at a cost of not exceeding 10 cents for loading and 15 cents for discharging per ton.

The foregoing would naturally involve commodious economic terminals and availing of the cheapest, best methods of loading and unloading the merchandise.

You will be kind enough to note from inclosed statements (A and B) that we have only provided for the barges being loaded, respectively, 60 and 75 per cent of full capacity. If they were run full of cargo—say, the 1,000-ton barge with 1,000 tons and the 2,000-ton barge with 2,000 tons of cargo—you can readily see that it would increase their annual earning capacity very materially, with no considerable increase in their fixed charges.

More and more it becomes a question of terminal facilities constructed on the broadest, largest, and most comprehensive basis which, among other conditions, would involve always having suitable working berths ready for barges when and as they might arrive, with a system which would involve their commencing to discharge or load within a half hour of the time of their arrival in port. This question of dispatch we are lamentably deficient in our appreciation of all along the Atlantic seaboard. Very much so at Philadelphia. Only last week we had occasion to send one of our young men aboard a steamer that was proceeding to Newport News, where the vessel went to receive over 1,000 tons of bunker coals. We are informed that the steamer arrived at Newport News at 8 p. m. on Sunday, and at 9 p. m. the same evening her bunker coals were being put aboard direct from the coal trestles, and she completed loading her 1,000 tons of coal late Monday afternoon, sailing, we believe, at daylight on Tuesday, if not on Monday. Another illustration is recorded in a letter from our New York manager of the ordinary dispatch prevailing at Norfolk and Newport News in the loading of cargo coal, in his letter of recent date, which reads as follows:

"Steamer *G.* (4,000 tons cargo).—Although this boat only went on time charter at Norfolk at 10 a. m. Saturday, February 25, the captain writes us that it was loaded 1 a. m. Sunday, the 26th, and sailed at 7 a. m. same day (Sunday) for Trinidad.

"Steamer *W.* (6,500 tons cargo).—This vessel received quick dispatch, arriving at Newport News on Thursday, February 23, and sailed on Saturday, February 25, fully loaded."

One of the phenomenal economies that we believe will subsequently be introduced through one or more mediums by railroad companies will be dispatch in unloading and reloading their cars and the consequent immense increase in the earning capacity of their car equipment.

You doubtless appreciate that the modern barges that may be constructed hereafter will be able to avail of all mechanical devices for facilitating the handling of cargo, as they would be built with their hatches at least something like those performing services on the Great Lakes and into which discharging and other machinery could be introduced with the greatest freedom and resultant efficiency.

Yours, very respectfully,

FRANK L. NEALL.

EXHIBITS.

1. Comparative summary of rates between Philadelphia and New York via all rail and Delaware & Raritan Canal and proposed free ship canal. Also class rates between New York and Philadelphia, with their added respective equivalents in tons of 2,000 pounds. All rail, Clyde Line (outside), Delaware & Raritan Canal, and proposed ship canal.

2. Class rates between Philadelphia, New York, Baltimore, etc., and illustrations of standard articles covered under the different railway classifications. General data on coke and coal and certain specified merchandise.

3. Freight rates and Delaware & Raritan Canal tolls between Philadelphia and New York on sundry commodities as mentioned.

4. Freight rates, Ericsson Line, Chesapeake & Delaware Canal, also tolls between Philadelphia and Baltimore on sundry commodities as mentioned.

Comparative summary of rates between Philadelphia and New York via rail and Delaware & Raritan Canal, and proposed free ship canal.

	All rail.	Delaware and Raritan Canal.[1]	Proposed free ship canal.	
			1,000-ton barges.	2,000-ton barges.
			Cents.	*Cents.*
Machinery	$4.40	$1.80	45	35
Lumber	2.40	1.60	45	35
Hay	2.10	1.80	45	35
Roofing paper	2.10	1.80	45	35
Hides (green)	2.10	1.80	45	35
Oil cake	1.90	1.60	45	35
Fertilizer	1.90	1.60	45	35
Cotton	2.40		45	35
Sugar (less than carload)	2.10	1.80	45	35
Manure	1.00	1.60	45	35
Sand	1.60		45	35
Sugar (carload)	1.70		45	35

[1] Includes tolls.

NOTE.—Above rates computed on basis of ton of 2,000 pounds.
NOTE.—Estimated respective rates of 45 and 35 cents per ton of 2,000 pounds is determined upon as being reasonable upon any and all ordinary traffic between New York and Philadelphia, via a free ship canal across New Jersey.

Exhibit A.

1. Barges of 1,000 tons capacity could be used.
2. These barges should be enabled to make 13 round trips in a single year, between Philadelphia and New York.
3. Averaging 75 per cent of capacity cargo, a single barge would carry 19,500 tons in one year.
4. Nineteen thousand five hundred tons, at 45 cents per 2,000 pounds, would give a gross revenue of $8,775. This upon a single barge costing $15,000.
5. Insurance at 3 per cent upon such a barge would be $450 per year.
6. Wages of a crew of 3 men and the feeding of crew would cost not exceeding $1,500 per year.
7. The repairs to the barge would be $500 a year.
8. The cost of towage would amount to $2,340 per year.
9. Estimated depreciation for each year, upon a basis of 20 years, would be $500 per year.
10. Interest upon $15,000 at 6 per cent per annum would be $900.
11. The total cost of the investment per year, wages, insurance, maintenance, depreciation, towage, etc., amounts to $6,190, leaving a profit of $2,585, or 17.2 per cent upon the investment.
12. Seventeen and two-tenths per cent plus 6 per cent upon the investment equals 23.2 per cent—a fair rate of return; that creates a rate (based upon the lowest class rates, $1.90 per ton of 2,000 pounds—sixth class) for transportation of only 24 per cent of the present all-rail rate and 28 per cent of the canal rate (based upon the lowest class rate, $1.60 per ton of 2,000 pounds—sixth class) via the Delaware & Raritan Canal. The quoted rate on Delaware & Raritan Canal includes tolls—the proposed canal would be a free public waterway.

Exhibit B.

1. Barges of 2,000 tons capacity could be used.
2. These barges should be enabled to make 13 round trips in a single year between Philadelphia and New York.
3. Averaging 60 per cent of capacity cargo, a single barge would carry 31,200 tons in one year.
4. Thirty-one thousand two hundred tons, at 35 cents per 2,000 pounds, would give a gross revenue of $10,920. This upon a single barge costing $23,000.
5. Insurance at 3 per cent upon such a barge would be $690 per year.
6. Wages of a crew of 3 men and the feeding of crew would cost not exceeding $1,600 per year.
7. The repairs of the barge would be $760 a year.
8. The cost of towage would amount to $2,340 per year.
9. Estimated depreciation for each year, upon a basis of 20 years, would be $750 per year.
10. Interest upon $23,000, at 6 per cent per annum, would be $1,380.
11. The total cost of the investment per year, wages, insurance, maintenance, depreciation, towage, etc., amounts to $7,520, leaving a profit of $3,400, or 14.8 per cent upon the investment..
12. 14.8 per cent plus 6 per cent upon the investment equals 20.8 per cent—a fair rate of return that creates a rate (based upon the lowest class rate, $1.90 per ton of 2,000 pounds—sixth class) for transportation of only 18 per cent of the present all-rail rate and 22 per cent of the canal rate (based upon the lowest class rate, $1.60 per ton of 2,000 pounds—sixth class) via the Delaware & Raritan Canal. The quoted rate on Delaware & Raritan Canal includes tolls. The proposed canal would be a free public waterway.

For the purposes of comparison the all-rail class rates between New York and Philadelphia are added with their equivalents in tons of 2,000 pounds:

	Class.					
	1	2	3	4	5	6
Class rates per 100 pounds........cents..	22	18	15	12	10½	9½
Class rates per 2,000 pounds........do....	440	360	300	240	210	190
Rates via Clyde Line Steamers (outside):						
Class rates per 100 pounds........cents..	18½	14½	12½	10	9	8
Class rates per 2,000 pounds........do....	370	290	250	200	180	160
Rates via Clyde Line, via Delaware & Raritan Canal at present not in effect, as no boats of this line are operated through the canal:						
Class rates per 100 pounds........cents..	18	14	12	10	9	8
Class rates per 2,000 pounds........do....	360	280	240	200	180	160
Rates via proposed ship canal (1,000-ton barge basis):						
Class rates per 100 pounds........cents..	2¼	2¼	2¼	2¼	2¼	2¼
Class rates per 2,000 pounds........do....	45	45	45	45	45	45
Rates via proposed ship canal (2,000-ton barge basis):						
Class rates per 100 pounds........cents..	1¾	1¾	1¾	1¾	1¾	1¾
Class rates per 2,000 pounds........do....	35	35	35	35	35	35

[Appendix 4.]

Representative class and commodity rates between New York, Philadelphia, and Baltimore.

[Rates apply via Pennsylvania Railroad.]

	Rate.					
	1	2	3	4	5	6
Class rates between New York and Philadelphia........	22	18	15	12	10½	9½
Class rates between New York and Baltimore........	34	29	23	18	15	12
Class rates between Philadelphia and Baltimore........	23	20	18	12	10	9

Articles are classified as follows (illustrations):

First class.—Boots and shoes, loose leather, clothing, machinery, drugs (less than carloads), knit goods, liquor (less than carloads), dry goods, dressed meats, silks, tea, agricultural implements, candy (less than carloads).

Second class.—Butter (in wood), leather (in bundles), dressed hogs, cotton waste (uncompressed).

Third class.—Drugs (carloads), candy (carloads), rope (less than carloads), liquor (carloads), condensed milk (in cans, boxed—less than carloads), babbitt metal (less than carloads), petroleum and (iron drums) petroleum products (of barrels less than carloads), oysters (in bulk—carloads), oysters (in bags—less than carloads).

Fourth Class.—Cotton (compressed bales), wood shingles (less than carloads), fertilizers (less than carloads), nails, spikes (less than carloads), terra-cotta drain pipe, sewer pipe (less than carloads), sand (less than carloads), curbing, flagging, paving stone (less than carloads), cotton waste (compressed), lime (bags, barrels, casks or drums—less than carloads).

Fifth class.—Petroleum and products (carloads), rope (carloads), shovels (carloads), marble (polished) (carloads), granite (polished) (carloads), oilcake (less than carloads), agricultural implements (carloads), feed (less than carloads), oats (less than carloads), barley (less than carloads).

Sixth class.—Sand (carloads), wood shingles (carloads), oilcake (carloads), fertilizers (carloads), lime (bags) (carloads), curbing, flagging, paving stone (carloads), oats (carloads), marble, granite (rough) (carloads), sewer pipe (carloads), feed (carloads), barley (carloads).

Rates on coke, in carloads, from Connellsville and Klondike regions, to—

Baltimore	per 2,000 lbs..	[1] $2.15
Philadelphia	do....	[1] 2.15
New York	do....	2.85
Boston	do....	[2] 3.50

Rates on bituminous coal to Baltimore and Philadelphia, New York and Boston.

From—	Baltimore.	Philadelphia.	New York.	Boston.[1]
District 1	$1.60	$1.60	$1.95	$2.60
District 2	1.85	1.85	2.20	2.85
District 3	2.00	2.00	....	3.00
District 4	1.85	1.85	2.20	2.85
District 5	1.85	1.85	2.20	2.85

[1] Includes switching charges of Bangor & Aroostook R. R. when not in excess of 30 cents.

District 1. Cumberland-Piedmont.
District 2. Connellsville of P. & Y.
District 3. Finleyville of P. & Y.
District 4. Other points in Pittsburgh and Youghiogheny.
District 5. West Virginia.
Bituminous coal, 2,240 pounds to ton.
Rates apply via Baltimore & Ohio R. R.

Rates on pig iron:		
Chester to New York	per 2,240 pounds..	$1.40
Chester to Baltimore	do....	1.05
Chester to Philadelphia	do....	.45
Rates on manure, Jersey City to Philadelphia:		
Gray's ferry	per 2,000 pounds..	1.00
Fifty-second Street	do....	.85
Rates on sand, Thirtieth and Market Streets, Philadelphia:		
To Jersey City	do....	1.05
Elsewhere in Philadelphia to Jersey City	do....	1.90
Rates on sugar:		
Jersey City and Brooklyn to Philadelphia	per 100 pounds..	.05
New York to Philadelphia	do....	.08½

ITEM.—For the purpose of comparison and general information, all rail-class rates as follows are submitted:

	1	2	3	4	5	6
New York to Philadelphia	22	18	15	12	10½	9½
New York to Baltimore	34	29	23	18	15	12
Philadelphia to Baltimore	23	20	18	12	10	9

[1] Includes dumping from cars to vessels when for transshipment by water.
[2] Includes switching charges of Bangor & Aroostook R. R. when not in excess of 30 cents.

Freight rates and Delaware & Raritan Canal tolls on merchandise between Philadelphia and New York.

Commodity.	All-rail rates per 100 pounds.	Canal freight rates per 100 pounds.[1]	Canal tolls per 100 pounds.
Machinery (1)	22	9 (5)	1 8/10
Lumber (4)	12	8 (6)	1 5½/10
Hay (5)	10½	9 (5)	1 8/10
Roofing paper (5)	10½	9 (5)	1 8/10
Hides, green (5)	10½	9 (5)	1 8/10
Ore (6)	9½	8 (6)	1 5½/10
Oilcake (6)	9½	8 (6)	1 5½/10
Fertilizer (6)	9½	8 (6)	1 5½/10
Cotton (4)	12	....	....
Sugar (5)	10½	9 (5)	3 1/10
Manure (3)	5	8 (6)	1 5½/10

[1] The freight rates include canal tolls.

Freight rates and Chesapeake & Delaware Canal tolls on merchandise between Philadelphia and Baltimore.

Commodity.	All-rail rates per 100 pounds.	Canal freight rates per 100 pounds.[1]	Canal tolls per 100 pounds.
Machinery (1)	23	20	2 5/10
Lumber (4)	12	10	3
Hay (5)	10	9	1 3½/10
Roofing paper (5)	10	9	1 1/10
Hides, green (5)	10	9	....
Ore (6)	9	8	7/10
Oilcake (6)	9	8	1 5/10
Fertilizers (6)	9	8	....
Cotton (4)	12	10	....
Sugar (5)	10	9	2
Manure (3)	18	16	7/10

[1] The freight rates include canal tolls.

[Appendix 5.]

PHILADELPHIA, *March 10, 1911.*

Mr. WILFRED H. SCHOFF,
Secretary Committee on Traffic, etc.

DEAR SIR: In reference to your inquiry about the amount of tonnage likely to be carried over the canal connecting Philadelphia and New York I would offer the following:

Figures have been made at different times in a conservative way by men interested in shipping as to tonnage and cost of same which have been based upon bulk cargoes, or, in other words, heavy commodities, taking the one commodity for a cargo. The shipping that I have been interested in on the Delaware River for the last 20 years has been the carrying of general merchandise, which takes in anything that can be shipped, from a farm product to a manufactured article.

At the present time the farm products of New Jersey and Delaware during the heavy season, which is July and August, find their quick market in Philadelphia and Wilmington. There are carried by water during these two months hundreds of thousands of baskets of truck directly from the farm to the open market. My company alone will average two to three thousand baskets per day for about 10 weeks, coming principally from the farms in and about Burlington, N. J., and Bristol, Pa. There are carried from the farms in the southern section in and about Gloucester County, N. J., in towed barges from thirty to fifty thousand baskets daily, which come to Philadelphia market.

Besides this, the Gloucester Ferry, operating between Gloucester and Philadelphia, during a period of about 10 weeks, carries about 30,000 teams, each team with a carrying capacity averaging 100 baskets, which are dumped into Philadelphia market.

Also the Camden ferries, all combined, probably carry a like number of teams loaded with light truck.

I give you these figures to show the vast amount of farm product that is being carried to the Philadelphia market from the New Jersey farms that would have a market in New York on a canal route where delivery could be made inside of 10 hours. The farmer would be interested, as he would have two markets instead of one for the sale of his product. At the present time, if New York is paying higher for farm products than Philadelphia, the farmer has to pack his product into freight cars, which are hot in summer time and unfit for this kind of shipment, and send it through to New York, where it arrives in such condition as to bring less than it might if carried by team or boat to Philadelphia. But if he could ship it by open barges, where it would not be closely covered and heated, New York would become a competitive market with Philadelphia for all kinds of farm produce. It is a known fact that at the present time farm produce is shipped in cars from southern New Jersey through to New York and Boston by rail. When there is not a solid train load it is held up at junction points and very often misses markets. Such delay in hot weather makes it unsalable, whereas if the canal were open and it could be gotten through within 10 or 12 hours this loss would not occur.

In reference to manufactured products along the Delaware River, I wish to cite several cases that have arisen in the last year or two, one in particular—a shipment from the crockery plants at Trenton was being made up for San Francisco, Cal., and Portland, Oreg. This shipment, consisting of about five carloads, was taken on board the boat at Trenton, brought to Philadelphia, and shipped by the Clipper Line from Philadelphia to San Francisco, which line took the shipment by all-water a long distance around Cape Horn. While the time of delivery was very much longer by this route than by rail across the continent, still the saving in freight and insurance amounted to $700, so that the consignee was willing to lose the time.

Again, a certain product manufactured at Trenton is being shipped daily to Chicago via the steamer route out of Trenton, all-water to Virginia, and then via railroad to Chicago. This shipment has to be transferred first via the company's team at Trenton, then aboard water lines from Trenton to Philadelphia, thence via outside steamer line from Philadelphia to Newport News, where it is loaded into freight cars and shipped by rail to Chicago. If this shipment were made all-rail out of Trenton it would be loaded from the machine into the freight car, locked, and sent directly through to destination, costing all-rail $1 per ton more than by the water and rail route. The water-carrying distances are very small compared to the distance by rail, but still this shows the saving to the consignee that is made when water routes can be used. There is very little difference in time via all-rail or via water and rail. In solid carloads, Trenton shipments will arrive in Chicago in about four days, while the water shipments will arrive in about six days; less than carload shipments to the same place by water and rail will equal the all-rail in delivery. This is caused by the holding of the less than carload shipments to make up solid carloads.

The advantage of the canal connecting New York and Philadelphia as to the saving of money to the manufacturer and to the consumer is an unknown quantity. No man to-day can figure the amount of money and actual saving of carrying of freight or the total worth or the time saved in transportation between the large cities that this water route will make. When the outside route is discontinued, the dangers of the sea cut out, it will mean that manufacturers will build their factories on the water fronts, where they can take the advantage of both rail and water transportation.

The shipper often appears to be in the dark as to how to ship his goods to the best advantage. In a great many instances rates do not figure; it is a question of delivery. Where delivery can be made by water, the water lines carry freight that would otherwise go by express if they had to depend on rail, the delivery over the water lines being so much better than over the rail lines.

Merchandise is now being shipped from Trenton to Boston via water that is marked and ordered to be shipped out of Boston to points in Maine via express. The shipper finds he can save the difference between express rates and water freight rates and still get a quick delivery at destination. Trenton is 35 miles nearer New York than Philadelphia is, and yet shipments are being made to Philadelphia from plants at Trenton, to be reshipped to New York via steamer, taking that long outside route, and still saving time over rail freight; whereas, if the canal were in operation, this same product would be delivered in New York inside of six or seven hours.

Instances can be quoted of all-water shipments between Trenton and Baltimore; for instance, floor tiling shipped from the factories at Morrisville, Pa., at 9 p. m. Saturday for the purpose of being placed on the floor of a hotel on Sunday (that being the only day of the week that work of this kind could be done). This shipment was placed aboard the steamer at Trenton on Saturday at 1 p. m., and was being laid on the floor

of the hotel on the next day, Sunday, at 7 a. m. This is not a rare occurrence, but is being done almost daily over the all-water line from Trenton to Philadelphia and from Philadelphia to Baltimore. Manufactured products are leaving Trenton for the South, leaving the factories as late as 3 and 4 o'clock in the afternoon, arriving at Norfolk and Newport News inside of 48 hours, ready for distribution at those points.

Respectfully, yours,

H. F. Stetser.

[Appendix 6.]

Reports on the probable commercial influence of the proposed waterway upon Newark, N. J., Trenton, N. J., and Richmond, Va., have been received by this committee from the Board of Trade of Newark, Chamber of Commerce of Trenton, and Chamber of Commerce of Richmond. These reports have been forwarded to Col. W. M. Black, Corps of Engineers, United States Army, New York City.

[Appendix C 4.]

STATEMENT BY WILLIAM C. MURPHEY, SECRETARY OF THE NEW JERSEY STATE SENATE.

New Jersey State Senate,
Office of the Secretary,
January 30, 1911.

Dear Sir: I am instructed by the Senate of the State of New Jersey to inform the Secretary of War that the senate has on this day introduced the following joint resolution:

Whereas, at a meeting of the Philadelphia-Trenton-New York Deeper Waterways Association, held at the State house, in the city of Trenton, it was resolved that the governor of this State be requested to appoint a committee of five to cooperate on behalf of this State with a committee of 50 of the Atlantic Deeper Waterways Association to consider and report upon matters in connection with a proposed cooperation between the State of New Jersey and the Federal Government, looking toward the construction of a ship canal across New Jersey and the development of the inland waterways of this and other coast States, in accordance with which resolution the governor did appoint Messrs. David Baird, Peter Campbell, Samuel Heilner, Benjamin F. S. Brown, and Frederick W. Donelly, as the members of such commission; and

Whereas, the said commission has met from time to time to discuss the matters submitted in accordance with the said resolution, and has received such information as could be afforded by the Federal Government with reference to the survey made by the engineers of the United States Army in such detail as the same is now perfected; and

Whereas, it is apparent that in order to bring about the undertaking of this important work by the Federal Government cooperation by the State of New Jersey is necessary and proper, since such cooperation on the part of the State is better calculated to induce the Federal Government to undertake the construction of this canal; and

Whereas, it is believed by the commission above referred to, upon information received from the Chief of Engineers of the United States Army, under whose direction said survey was made, that the right of way of the said canal, according to the survey made, will require about four thousand acres of land, the cost of which, including damage claims for water rights extinguished, is estimated to be about five hundred thousand dollars; and

Whereas, it is believed that the benefits which will accrue to the State of New Jersey by reason of the construction of the proposed canal are a sufficient warrant for the cooperation of the State with the Federal Government, in the construction of said canal; and

Be it resolved by the Senate and General Assembly of the State of New Jersey, (1) That the construction of a canal across the State of New Jersey, connecting New York Bay with deep water in the Delaware River at Bordentown, New Jersey, by the Federal Government, is an enterprise which is likely to result in great benefit to this State and its inhabitants, in encouraging the various industries of the State, and affording a more ready method of communication and transportation between points within this State and other points in this country and abroad, particularly in view of the importance of this canal as a necessary link in the intra-coastal system of inland

waterways extending from Maine to Florida, which, when completed, will be of inestimable benefit to transportation along the entire Atlantic seaboard.

(2) That in order to bring about the construction of this canal and its completion within as short a time as possible, on behalf of the people of this State, it is hereby declared that when the Government of the United States shall finally settle upon the route of the said canal and shall make provision for its construction by suitable appropriation, the State of New Jersey shall acquire the right of way for the said canal by purchase or condemnation from the owners thereof and cede the same to the Federal Government for the use of the Government in constructing and maintaining the said canal, upon condition that the said canal, when completed, shall be free and open to the commerce of the world, without tolls or charges for the passage of vessels or freight thereon; provided the right of way can be obtained by purchase or condemnation for a sum not exceeding five hundred thousand dollars, or such sum as may be appropriated by the Legislature for that purpose at the time when such appropriation and other legislation necessary to carry into effect the purposes of this resolution, shall become necessary and appropriate.

(3) That a certified copy of this resolution be forwarded by the Secretary of the Senate to the honorable the Secretary of War.

(4) This joint resolution shall take effect immediately.

Respectfully,

Wm. C. Murphey,
Secretary.

Hon. George L. von Meyer,
Secretary of War,

[Appendix C 5.]

STATEMENT FROM MR. L. J. KANE, SECRETARY OF THE RIVERSIDE METAL CO., OF RIVERSIDE, N. J.

There is no public wharf; there is a wharf without railroad connection, concession for its use could be obtained without difficulty. There is no public land available for wharf construction. Water transportation would benefit a manufacturing community of 5 square miles, population 10,000, and a farming community of 20 square miles, population 1,000. The freight rate by rail to New York is 15 cents per 100 pounds; to Providence and Boston, 25 cents per 100 pounds. Water rates same as railroad. Ninety-nine per cent of freight is carried by rail, 1 per cent by water.

Lack of proper connection with water lines is the cause of large percentage of rail shipments.

STATEMENT FROM F. W. ROEBLING, SECRETARY OF JOHN A. ROEBLING'S SONS' CO., OF TRENTON, N. J.

Can not see that it will be of great advantage to the city of Trenton. Vessels passing through the canal from New York would be obliged to come up the Delaware River about 6 miles and discharge at the river front at the lower end of the city. Practically all manufactories have been located so as to have the best railroad facilities which has taken them from one-half to 4 miles away from the river. Cartage charges must, therefore, overbalance any saving by water transportation. Continuance of the waterway far south would, in our judgment, be more advantageous to this city than the canal from New York to Bordentown, and then with moderate tolls on the Delaware and Raritan Canal, in connection with the canal from New York and the South to Bordentown it would, in our opinion, be of great advantage to Trenton. The Delaware and Raritan canal as it stands to-day would be of great benefit to Trenton were it not for excessive tolls charged. They make it impossible to operate transportation at a profit.

In addition to the works at Trenton, employing 4,000 people, this company also operates a steel works at Roebling, N. J., with 2,500 hands. These works are 4 miles below the outlet at Bordentown, and are located on the river. For this place the waterway south and north is likely to be of great advantage and importance, and if in the future the Delaware River is made navigable for 5,000-ton steamers, foreign commerce would be available.

We believe the contemplated inland waterway from New York to the far south would be of enormous value to great communities which are practically inland to-day, not on account of full cargoes so much as from small shipments from many places on or near its location. This kind of traffic is, of course, impossible for outside lines and is of slow growth and would depend on manufactories being built in the future.

STATEMENT FROM J. WALTER MILLER, OF THE INDEPENDENT BRICK SELLING CO. OF TRENTON, N. J.

We are manufacturers of brick and at the present time have a capacity of about 40,000,000 per year. Under the present conditions our market is limited owing to the excessive freight rate by rail. Should this canal become a reality the world would be our market instead of a field within a radius of 50 miles. Our supply of clay is unlimited, and should we receive the benefit of this canal would immediately increase our capacity from 100 to 200 per cent. However, taking our present capacity we present the following facts:

We consume about 20,000 tons of coal per year which is all received by rail at a higher freight rate than same could be received by water. Our outgoing shipments represent 125,000 tons. Owing to the depth of the present channel in the Delaware River we have been unable to get captains to give us rates by water, although both of our factories are in a position to use water deliveries. We have at the present time sidings at the factories for the receiving and shipping of material by rail, and docks for water delivery.

To cite the difference between the freight rates on our commodity between rail and water would say, that our present rate by rail to New York is $1.90 per ton. Trenton shippers who have the use of the canal are paying a rate of $1 per ton on fancy pressed brick and a lesser rate on common brick, such as we manufacture. The present rate by rail to Philadelphia is 65 cents per ton, and we have had a rate quoted of less than 20 cents per ton by water, providing certain spots in the river were made available for navigation.

We have had many inquiries, in fact, have had enough inquiries to take our entire output by water, but have been unable to do anything during the past several years. If we were to enjoy the use of a canal from our factories to New York and Philadelphia we would save at least $50,000 per year on our present freight rates by rail on outgoing materials. This is based on our present capacity. Should the canal, however, be built we would have, as previously stated, the world for our market and will materially increase our capacity, so that the saving will be problematic, figured on the quantity manufactured. Would estimate that if this canal is built, we can add as increased profits at least $100,000, which would be saved between the present rates by rail and rates by water.

Another saving to us would be the elimination of many serious delays on railroad shipments. We have been held up at times from 10 days to 2 weeks in getting cars a distance of 35 miles. When taking the matter up with the railroad company we receive their usual reasons covering such cases, which of course does not help us in straightening the matter out with our dissatisfied customers. If this canal were built and the various spurs established from a main canal we could ship practically all of our output by water, as our market would be so extended that our present capacity would be inadequate to supply the demand to points that could be reached by water.

STATEMENT OF T. S. UNDERHILL, OF WISTAR, UNDERHILL & CO., PHILADELPHIA, PA.

The terminal facilities are held by individuals or corporations which are extended to all on equal terms subject only to the owner's convenience.

Lumber is brought in by vessel to Philadelphia at vessel rates and hauled to various parts of the city or transferred into cars at a nominal charge for this transfer and taken to various parts of the city, enabling the purchasers to secure the material on the combined water rate to Philadelphia and shifting charge about Philadelphia at a lower cost than it could be brought to their siding if shipped by rail; and this material is even shipped out into the suburbs for 6, 8, or 10 miles outside of city limits to advantage after being transferred from vessel to cars at Philadelphia.

The rates vary, depending upon the point of shipment. Lumber comes here by rail and by water from Louisiana, Alabama, Florida, Virginia, South Carolina, North Carolina, Maine, and Nova Scotia. The rates by water, as far as we are able to learn, would range anywhere from $1.50 to $2.50 and possibly $3 per thousand feet; at times less than by rail. There are terminals easy of access to the center of the city. The cost of hauling from water terminals would be about the same as that from railroad terminals.

STATEMENT OF MR. CALVIN TOMKINS, COMMISSIONER OF THE DEPARTMENT OF DOCKS AND FERRIES OF THE CITY OF NEW YORK.

Construing the term "terminal facilities" to mean such facilities as are afforded by car floats, transfer bridges, and railroad connections, it may be stated that there

are no such facilities owned by the public which are extended to all on equal terms. The various terminals are all controlled by corporations, either for their exclusive use, or by arrangement with railroads, etc., on terms previously agreed upon.

There are terminal facilities held by private corporations, as well as practically all the trunk lines of railroads, which are located in the Boroughs of Manhattan, the Bronx, Queens, Brooklyn, and Richmond, but I am unaware that they are extended to all on equal terms.

There are a number of piers and bulkheads owned by the city which are available for public use, and there is space available for the construction of additional piers and bulkheads in the various boroughs, and the matter is being taken up by the commissioner of docks, who has ordered the construction of additional wharfage facilities at such localities where the demands of commerce require them.

As stated before, all of the terminals are not open for public use and the following list of terminals is submitted:

New York Central & Hudson River Railroad Co., One hundred and thirty-fifth to One hundred and forty-third Streets, North River, bulkhead, car float, and railroad.

New York Central & Hudson River Railroad Co., Fifty-ninth to Seventieth Streets, North River, 8 piers, car float, and railroad.

Pennsylvania Railroad Co., Thirty-seventh to Thirty-eighth Streets, North River, 2 piers, car float, and railroad.

New York Central & Hudson River Railroad Co., Thirty-fifth to Thirty-seventh Streets, North River, 1 pier, car float, and railroad.

New York Central & Hudson River Railroad Co., Thirtieth to Thirty-seventh Streets, North River, 4 piers, car float, and railroad.

Delaware, Lackawanna & Western Railroad, Twenty-eighth Street, North River, 1 pier, car float.

Erie Railroad Co., Twenty-eighth to Twenty-ninth Streets, North River, transfer bridge and railroad.

Terminal Warehouse Co., Twenty-seventh to Twenty-eighth Streets, North River, transfer bridge and railroad.

Erie Railroad Co., Twenty-seventh to Twenty-eighth Streets, North River, transfer bridge and railroad.

Lehigh Valley Railroad Co., Twenty-sixth to Twenty-seventh Streets, North River, transfer bridge and railroad.

Baltimore & Ohio Railroad Co., Twenty-fifth to Twenty-sixth Streets, North River, transfer bridge and railroad.

Delaware, Lackawanna & Western, Leroy Street, North River, 1 pier, car float.

Central Railroad Co. of New Jersey, Pier 32, foot Canal Street, 1 pier, car float.

Pennsylvania Railroad Co., Hubert to Vestry Streets, 3 piers, car float.

New York Central & Hudson River Railroad Co., Harrison Street, North River, 1 pier, car float.

Baltimore & Ohio, Jay Street, North River, 1 pier, car float.

Erie Railroad Co., Chambers Street, North River, 2 piers, car float.

New York Central & Hudson River Railroad Co., Barclay Street (Pennsylvania Railroad), 2 piers, car float.

Delaware, Lackawanna & Western, Dey Street, North River, 1 pier, car float.

Central Railroad Co. of New Jersey, Albany to Cedar Streets, North River, 2 piers, car float.

Baltimore & Ohio Railroad Co., Rector Street, North River, 1 pier, car float.

Pennsylvania Railroad Co., Morris to Rector Streets, 2 piers, car float.

Lehigh Valley Railroad Co., Battery Place to Morris Street, 2 piers, car float.

Pennsylvania Railroad Co., Battery Place, 1 pier, car float.

New York Central & Hudson River Railroad Co., Broad Street, East River, 1 pier, car float

Erie Railroad Co., Coenties Slip, East River, 1 pier, car float.

Long Island Railroad Co., James Slip, East River, 2 piers, car float.

Delaware, Lackawanna & Western, Catherine Slip, East River, 1 pier, car float.

New York Central & Hudson River Railroad Co., Rutgers Slip, East River, 1 pier, car float.

New York, New Haven & Hartford Railroad Co., Montgomery Street, East River, 3 piers, car float.

Lehigh Valley Railroad Co., One hundred and twenty-fourth Street, bulkhead, car float.

Pennsylvania Railroad Co., One hundred and twenty-fifth Street, bulkhead, car float.

New York, New Haven & Hartford Railroad Co., Jefferson Street, 2 piers, car float.

Bronx.

New York Central & Hudson River Railroad Co., East One hundred and sixty-seventh Street, Hudson River, transfer bridge, railroad.
Lehigh Valley Railroad Co., East One hundred and fiftieth Street, Hudson River, transfer bridge, railroad.
Delaware, Lackawanna & Western, East One hundred and fiftieth Street, Hudson River, transfer bridge, railroad.
Harlem Transfer Co., Railroad Avenue and Mott Haven Canal, transfer bridge, railroad.
Central Railroad Co. of New Jersey, Lincoln and Third Avenues, transfer bridge, railroad.
New York, New Haven & Hartford Railroad Co., Willis Avenue, transfer bridge, railroad.
New York Central & Hudson River Railroad Co., East One hundred and forty-first Street, transfer bridge, railroad.
New York, New Haven & Hartford Railroad Co., Cabot Street Yard, transfer bridge, railroad.

Queens.

Long Island Railroad Co., Borden Avenue to Sixth Street, transfer bridge, car float, and railroad.
Long Island Railroad Co., Newtown Creek to Dutch Kills, 2 piers, car float, and railroad.

Brooklyn.

Green Street, 1 pier, car float.
North Fourth to North Tenth Street, 4 piers, transfer bridge and railroad.
New York, New Haven & Hartford Railroad Company, North First Street, 2 piers, transfer bridge and railroad.
Delaware, Lackawanna & Western, Wallabout Channel, transfer bridge, car float.
New York Central & Hudson River Railroad Company, Wallabout Basin, 1 pier, car float.
Pennsylvania Railroad Company, Wallabout Basin, car float.
Lehigh Valley Railroad Company, Wallabout Basin, car float.
Erie Railroad Company, Wallabout Basin, car float.
Jay Street Terminal, Jay Street, transfer bridge, car float.
New York Dock Company, Baltic Street, piers, transfer bridge, car float.
New York Dock Company, State Street-Fulton Street, piers, transfer bridge, car float.
Bush Terminal Company, Fifty-first Street–Fortieth Street, piers, transfer bridge, car float.
Pennsylvania, New York & Long Island Railroad Company, Sixty-fifth Street, piers, transfer bridge, car float.

Richmond.

Baltimore & Ohio Railroad Company, St. George, piers, transfer bridge, car float.
American Dock & Trust Company, Tompkinsville, piers, transfer bridge, car float.

STATEMENT BY MR. HENRY B. HERBERT, OF NEW YORK.

It seems to me that as an important aid to the commerce of the country, the project has been wisely conceived. Under the operation of this all-water route it will not only be possible to establish a minimum freight rate for transportation but it will insure some reliability in the delivery of goods at points of destination. The possibility of an immense flow of interchanging commerce via these waterways is apparent and justifies the undertaking.

STATEMENT BY MR. GEORGE E. BARTOH, PRESIDENT OF THE PHILADELPHIA BOURSE, PHILADELPHIA, PA.

The present traffic by the inland waterway between the Delaware River and New York Bay is exceedingly small. Conditions with which you are perfectly familiar account for the insignificant volume of the present traffic. I am personally familiar with a large portion of the route, having made several trips through the canal, and you will undoubtedly agree with the suggestion that no canal, located as is the present canal, and with locks, gates, and basins of the dimensions of those found on the present canal, can be expected either to carry a reasonable share of traffic or to develop any volume of business.

There are certain classes of improvements which, it seems to me, must be considered from a viewpoint other than that of the existing conditions; in other words, we must consider them from the broad standpoint of the effect of the improvement upon the future conditions. To illustrate clearly what I mean, if the first improvements to the Sault Ste. Marie had been conditioned upon the traffic then existing through that waterway there would have been no improvement made whatsoever, as prior to the improvement there was no traffic. In the same way, if the transcontinental railroads had been built solely upon the traffic existing prior to their construction, and that had been assumed to be the volume of traffic that they would have after construction, there would have been no transcontinental railroads built.

It is a well-known and thoroughly proven fact that facilities create business, and it is impossible to conceive that an improved, modern waterway of proper width and depth, with proper entrance gates and locks, if such be required, between the New England section and New York district, with its millions of population, and Philadelphia and the southern territory to be served from Philadelphia, would not carry a volume of business that would amply compensate for the construction of such a waterway.

It is true that the New Jersey canal would not come up to the fullest measure of success until it had as a feeder an improved link connecting the Delaware Bay with the Chesapeake Bay, but even without such a link Philadelphia and the other towns on the Delaware River, with the immediately tributary country, ship an enormous tonnage of merchandise to New York and New England points. Much of this now goes by rail, and a large tonnage goes by water. Just what percentage of the present rail tonnage would seek an improved inland-waterway route it is impossible to calculate, but it is certain that at somewhat lower rates and with the certainty of delivery which attaches to the movement of freight over such waterways, a large proportion of such presently moved rail freight would go by the inland waterway. Exactly the same line of reasoning applies to the present large movement by vessel outside the Capes.

Attention is invited to the special reports of New York Produce Exchange, Trenton Chamber of Commerce, Board of Trade of Newark, and Board of Trade of Camden.

[Appendix C 6.]

Board of Trade,
Camden, N. J., November 2, 1910.

Dear Sir: I am in receipt of your several favors of August 30 and October 25, and beg to take up and answer your questions as far as possible as contained in your latter letter, as follows:

1. The city of Camden is now building a public wharf at the foot of Cooper Street (opposite Arch Street, Philadelphia), and has purchased and owns land at Spruce and Clinton Streets, upon which it is proposed to build another public wharf.
2. A line of the Pennsylvania Railroad passes along the end of the Cooper Street Wharf, but as yet no plans have been made to run a switch out on the wharf. There are, however, no obstacles to such being done as soon as conditions warrant.
3. There are no wharves, as far as I know, held by individuals or corporations which are extended to all on equal terms, except, possibly, the old sugar refinery wharf at the foot of Linden Street, now owned by Mr. Arthur Dorrance.
4. There are several tracts of river front property not yet owned by the railroad corporations which may be purchased on very favorable terms. Several of these tracts are in the southern section of the city and have a deep water front.
5. There are a number of more or less modern wharves owned by and held for the exclusive use of such corporations as the New York Shipbuilding Co., the Licorice Works, the Chalk Works, and the public-service corporation, and also for the use of several lumber companies.
6. Including Philadelphia and its suburbs, not less than three and a half millions of people receive the benefit of water transportation in this vicinity.
7. We can not give you the freight rates by rail unless we knew from what points these rates were to apply.
8. The same is true of the freight rates by water.
9. The industries are chiefly located on or adjacent to either the Delaware River or Cooper Creek, but those industries located along the Delaware River from Cooper Point to the mouth of Cooper Creek, and along Cooper Creek from its mouth to Federal Street, have no railroad facilities, and the average haul to the nearest railroad siding would be about one-half mile.
10. See paragraph 9.

11. There is no record of the amount of package freight available. Arrangements are being made with the Delaware River Navigation Co. to have their boats stop at the Cooper Street Wharf, when completed, to load and discharge freight and passengers for all upriver points, and also with the Wilson Line to take on passengers and freight for Chester and Wilmington. In this connection, attached please find letters received some time ago by our committee when the agitation for a public wharf was begun. From these letters you will see that there would be available a considerable amount of package business if a public landing and good channel facilities were furnished. We did not at that time go as far as to take in the question of New York traffic, which would no doubt bring forward stronger letters.

12. It is impossible at the present time to obtain the proportion of freight carried by rail and water accurately, but it has been estimated by a good authority that about $7\frac{1}{2}$ per cent of our traffic is carried by water.

13. With regard to the difference between the freight by rail and water, the chief cause for this is the fact of not having sufficient depth of water on the New Jersey side of the Delaware River or on Cooper Creek.

When the last survey of the Delaware River was made, everything was done for Philadelphia at the expense of Camden. Prior to that work being done, we had from 12 to 15 feet of water, practically all along the New Jersey shore, but now in many places north of Clinton Street there is not over 6 feet.

Statistics as to the water traffic along Cooper Creek, which is tributary to the Delaware River, may be of interest, and we herewith attach a copy of such statistics as have been recently furnished the Engineers office at Wilmington.

In our city we have numerous factories, whose entire product is sent to New York for distribution, and a canal connecting the Delaware River and New York Bay would mean great saving in several respects. It will, however, only be useful to the great majority of communities located along its course, provided their interests are not sidetracked for the benefit of the larger cities. Should this channel be made to a depth of 16 feet from Bordentown south, and this 16 feet be provided in the center of the river without dredging an equal channel to the public docks along the route, it would be impossible for these boats to make intermediate landings, and, consequently, the improvement would be of little use except for through traffic.

The savings to be effected would be—

First. *In time.*—While rail is quicker, there is always the liability of greatly delayed shipments. Lately, we have had our attention called to rail shipments in less than carload, taking 5 to 6 days and even 10 days to arrive in New York from Philadelphia or Camden, which delay was due to the car being sidetracked or lost. This can not happen by boat, for when a boat starts out it usually maintains its speed and its time of delivery can be counted upon accurately.

Second. *In freight rates.*—At the present time we have a rail freight rate on first-class merchandise in less than carload of 22 cents per hundred and to New York a water rate of 20 cents per hundred. On the rail rate, the merchandise is to be delivered on the platform of the railroad company, whereas in the water rate the rate applies from the mill door to the wharf in New York, which is equivalent to at least 4 to 5 cents per hundred pounds for expense of hauling to the docks.

Trusting that this information may be of some use to you, I am,

Yours, very truly,

CHARLES S. BOYER,
Chairman Waterways Committee.

Col. W. M. BLACK,
Corps of Engineers.

CHILDS GROCERY CO.,
Camden, N. J., June 12, 1908.

DEAR SIR: We have been trying for some time to think of a plan by which to bring the very great necessity of having a Camden landing for the up and down river boats before the proper authorities, but up to our conversation this afternoon we had formed none, that taken single handed, looked anything like success. It would seem to us that a city growing as ours would, as a matter of pride if not necessity, have at least one or more public landings of this sort for the accommodation of our own industries instead of compelling all who do any shipping to go to Philadelphia.

It is quite unlikely that anyone of your committee has any idea of the extent of this traffic, and had I sufficient notice I could have said very definitely just what our shipping amounted to by water, which if we had facilities could all be done from Camden at a very great saving of time, to say nothing of expense. To give you an idea of the points to which we ship I will name the different towns to which we ship via water:

Mount Holly, Burlington, Bordentown, Bristol (3 stores), Trenton (9 stores), Bridgeton, Wilmington (3 stores), Salem, Riverside, and New Castle.

These 21 stores are, of course, all outgoing. We also want to speak of incoming in the fall. We have on a number of occasions had to refuse offers of canned goods at very much lower prices by boat than rail because no suitable landing was to be had. We might mention many other ways. Lack of accommodation in this respect is a very great drawback to us in shipping and receiving goods and a considerable loss as well

It will be a very great pleasure to give any information or support to your committee which they might ask to assist them in this movement.

We are, very respectfully,

Geo. R. Pelouge, *Treasurer.*

Mr. C. S. Boyer,
Chairman Waterways Committee, Camden, N. J.

Childs Grocery Co.,
Camden, N. J., June 16, 1908.

Dear Sir. In my letter of the 9th instant, it was impossible, for lack of time, to explain just the extent of what I called incoming shipments; also just what they were. In the first place during the fall months our receipts of canned goods are very heavy. Beginning with say, the middle of July and continuing until the latter part of October, 1907, we received in round numbers 85,000 cases of canned vegetables, many of which (surely two-thirds) were shipped from New Jersey, Delaware, and Maryland. In a number of cases it would have saved quite a sum of money had we been able to receive shipments by the way of water to Camden. Only yesterday we received notice of 100 barrels of pickles consigned to us at Bush Line Pier, Philadelphia. This means cartage of same from there, making five loads, and the time, etc., for team. To-day we are having 500 cases of baked beans hauled from the Ericsson Pier at the packer's cost. Now we will, for the moment, forget the expense. What must be the impression a shipper has of a city with a hundred thousand population and not a public wharf on a river front of about 3 miles. How many small towns on this river can you call to mind that have no public landing? Very few that I can recall. This state of affairs can not help being a detriment to the growth of our town, and until we do have every facility for the manufacturer and shipper we can hardly expect to keep pace with our competitors in cities located in progressive up-to-date towns.

If we can be of further assistance to you in what we think a long stride in the direction of a prosperous, up-to-date city, we will be very glad to do so, if you will let us know.

Wishing you all possible success, we are, respectfully, yours,

Geo. R. Pelouge, *Treasurer.*

Mr. C. S. Boyer,
Chairman Waterways Committee, Camden, N. J.

C. B. Coles & Sons Co.,
Camden, N. J., March 29, 1909.

Dear Sir: As per your request of to-day, the amount of lumber received on our wharf from February, 1908, to February, 1909, is as follows:

Tons of freight		12,435,075
Value		$149,618.26
Steamers	number	4
Sailing vessels	do	19
Barges	do	39

We hope this will be of advantage to you in making up your statistics for the deep-water channel.

We have a large car trade which would average about 50 per cent of our boat trade, which is shipped direct from the manufacturers to the consumer, not stopping in Camden in transit, and as much more is shipped direct to our yard and hauled out by teams. The interchange of cars by the different railroads over the Belt Line would save heavy carting and would decrease the cost to the consumer.

Very respectfully,

C. B. Coles & Sons Co.

Mr. Louis T. Derousse,
Secretary of Board of Trade,
Camden, N. J.

C. B. Coles & Sons Co.,
June 9, 1908.

Dear Sir: I have letter relating to river-front improvement for Camden.

Allow me to suggest the board recommending to extend Cooper Street Dock out into the river so that it will make a good landing for up-river boats to take on passengers and freight to be distributed to the different towns along the river and creeks.

I suggest the Van Sciver Line of steamers take freight from Philadelphia wharf and distribute it to the different towns along the river until it gets to Rancocas Creek; then deliver to the different landings along the creek till it gets to Hainesport; then it is a short haul from Hainesport to Mount Holly.

Much of the small freight for Moorestown and Mount Holly was delivered to Moorestown and Mount Holly by express wagons that met the boat that delivers at the different landings, which makes it very handy for people along the line, and I will say especially for Moorestown. If we had such a place on this side of the river, it would save us much time crossing the river and likewise the expense.

I would recommend that you urge council to take action in this matter.

Very truly, yours,

Charles B. Coles.

Mr. Chas. S. Boyer,
Chairman Waterways Committee,
Camden, N. J.

Gately & Hurley Co.,
Camden, N. J., June 9, 1908.

Dear Sir: Regarding the proposed public wharf for Camden will say that we regard it as an absolute necessity to the freight handlers of this city.

We have heard several of our large shippers talk on the subject and they are all of the opinion that a public wharf would facilitate the handling of freights and be a cheaper and safer means of shipping.

As for ourselves we can safely say that if we were able to ship direct from Camden by boat we could serve our customers more satisfactorily and save considerable money.

We are daily receiving and shipping goods to Burlington, Trenton, Pennsgrove, Salem, Chester, Wilmington, and other points on the Delaware River, or that can be reached by boat service on the river connecting with smaller channels. We also receive considerable freight from New York, Boston, and other points that we would like to have forwarded by water. Considerable of it now comes this way, but we are obliged to send to Philadelphia for most of it.

It appears that one of the New York boat lines, realizing the value of Camden patronage and not having any wharf here where they could land their boats, they have made arrangements with one of our express companies to haul all Camden freight over here.

This was a very good move on their part, but how much nicer it would be if the goods were unloaded in Camden and we could send our own teams for them. We believe that we would save 24 hours, and nowadays not only every hour but every minute is valuable to a business man, and the sooner he can get goods to his customers, in making shipments or in receiving shipments to deliver to him, the better off will he be.

We feel satisfied that a public wharf will be a great benefit to the business and manufacturing interests already located in our city, and it may be an inducement for others who would locate here, if they could load the goods they manufacture on boats, the same as they do in other cities.

Trusting that you will be successful in making arrangements for a public wharf, we are,

Yours, truly,

Gately & Hurley Co.

Mr. C. S. Boyer,
Chairman Waterways Committee,
Camden, N. J.

GATELY & HURLEY CO.,
Camden, N. J., June 16, 1908.

DEAR SIR: Replying to your favor of recent date, wherein you wish us to give you an estimate on the amount of goods shipped up and down the river, will say, we have figured it out as close as we can and find that about from $15,000 to $18,000 worth of goods are shipped by us to different points on the Delaware River that can be reached by boat. This could be increased very materially had we the facilities for doing so.

We would consider a public wharf for Camden one of the greatest accommodations Camden could give for the benefit of its business and manufacturing industries, and sincerely trust you can influence the city fathers to build a wharf suitable for the landing of not only river boats but ocean-going steamers.

Yours, very truly,

WILLIAM LEONARD HURLEY, *President.*

Mr. CHAS. S. BOYER,
Chairman Waterways Committee,
Camden, N. J.

RONALDS & JOHNSON CO.,
Camden, N. J., June 13, 1908.

DEAR SIR: We are losing a large number of orders because of the lack of water transportation from Camden. This applies particularly to up-river points. The greater number of our customers along the upper Delaware prefer water shipments. Camden interests would be vastly benefited if we had a public dock where the up-river boats could stop. We are unable at short notice to give you any reliable data as to tonnage, etc., but will take this up later and advise you fully.

Yours, respectfully,

GOULICK.

Mr. C. S. BOYER,
Chairman Waterways Committee,
Camden, N. J.

WARREN WEBSTER & CO.,
Camden, N. J., June 15, 1908.

DEAR SIR: We acknowledge receipt of your favor of June 11, and would say that we are very much interested in anything that would tend toward the improvement of the business facilities of our city, and it would be an accommodation to us if we could land our goods on a dock in Camden for the various steamship companies to collect the same, rather than to ferry them across the river.

Would say; however, that, as regards to merely local shipping, we have practically nothing—receiving only a few castings from Chester at odd times throughout the year.

The following is the approximate tonnage shipped by us via the various steamship companies from Philadelphia, covering the past year, including May, 1908:

	Tons.
Ericsson Line to Baltimore	$6\frac{1}{2}$
Clyde Line to New York	$2\frac{1}{4}$
Clyde Line to Norfolk	33
Merchants & Miners' Transportation Co. to Boston	25
Merchants & Miners' Transportation Co. via Savannah	5
Export shipments to London, England	3

We receive considerable incoming freight also, but the majority of this is by rail, which is brought about by the very meager water transportation facilities which we have for goods which are incoming.

We deal with a foundry at Bridgeton, N. J., which could ship to us by water should there be a satisfactory water service with a wharf in Camden.

As we said before, we are heartily in favor of improvement in the waterways through the whole eastern coast of this country and anything which would facilitate economical transportation would be appreciated by us.

Yours, very truly,

WARREN WEBSTER & CO.

Mr. CHAS. S. BOYER,
Chairman Waterways Committee,
Camden, N. J.

KEYSTONE LEATHER CO.,
Camden, N. J., June 12, 1908.

DEAR SIR: We are in receipt of your favor of the 11th inst., in reference to the demand made by the Camden shippers for a public dock along the Delaware River front, at which the up and down river steamboats will stop and take up or leave freight for or from these points, thus avoiding the necessity of hauling of such shipments to Philadelphia.

This would be a very great benefit to us, as we ship considerable merchandise in the way of finished leather to Bristol, Pa. On a general estimate, would say, that we ship about 1 ton daily.

Trusting that you will meet with success in having the steamboats stop at a central wharf in Camden, we are,

Very truly, yours,
C. A. REYNOLDS, *President.*

Mr. CHARLES S. BOYER,
Chairman Waterways Committee,
Camden, N. J.

STATISTICS OF COOPER CREEK.

The importance of Cooper Creek as a carrier, or possible carrier, of shipping is best exhibited from the following figures:

Number of vessels arriving and departing in 1909	2,400
Net tonnage of vessels arriving and departing in 1909	651,260
Actual tonnage of merchandise arriving and departing in 1909	244,222
Actual value of merchandise arriving and departing in 1909	$2,073,188.60
Capital invested in industries located along Cooper Creek	$9,890,500.00
Number of employees in the industries located along Cooper Creek	5,377
Total actual tonnage arriving and departing for 1906, 1907, 1908, and 1909	908,043
Total actual value of tonnage arriving and departing for 1906, 1907, 1908, and 1909	$7,866,186.40
At a difference in freight rate of 30 cents per ton, the saving effected by this waterway has been, in four years	$272,412.90
The saving on coal receipts for the year 1909 over the rail rate was	$9,933.40

If the boats could have been loaded to their full capacity the actual saving would have been 25 per cent in excess of the above figures.

The chief commodities shipped and received by the various industries along the creek consist of coal, chemicals, pipe, building stone, sand and clay, oil, lumber, corn, salt, hay, and manure.

As to the difference between rail and water rates, the following replies to our inquiries from the mills located along the creek will prove interesting. Since these replies were strictly confidential, they are designated by numbers:

No. 1003, about 65 per cent more by rail than on water freights.
No. 1007, 3 cents per hundredweight on oils.
No. 1008, $2,560 on 2,500 tons, or $1.024 per ton additional.
No. 1009, 33 cents per ton on coal additional by rail than water.
No. 1011, 30 cents per ton on coal additional by rail than water.
No. 1012, $1,350.60 on 9,004 tons, or 15 cents per ton additional on building materials by rail.

[Appendix C 7.]

NEW YORK PRODUCE EXCHANGE,
New York, December 3, 1910.

DEAR SIR: I have the honor to acknowledge receipt of your letter of November 30 in regard to the proposed line of canal across New Jersey connecting the waters of Raritan Bay and the Delaware River, and also am in receipt from Mr. Welding Ring of your letter of the same date addressed to him. On presentation of these communications to the board of managers of the exchange, the whole matter was referred to the president with power.

For precisely the reasons you suggest, I quite agree with you that the question is one in which the merchants of New York should take an active interest, and I will take the matter in hand personally and see if I can not arouse interest enough to draw forth some expression that may be of value to you. I feel that in all public expressions on public questions I must represent the opinions of the members so far as it is possible

to ascertain them and not permit my personal opinions and judgment to stand as that of the exchange. For this reason I will study the question from the standpoint of the exchange and communicate the results to you as fairly, as impartially, and as soon as possible.

I regret exceedingly that you have received such an unfavorable impression concerning the action in the matter already taken by the exchange, and for the purpose of removing that impression I inclose herewith a copy of the original resolutions adopted by the canal committee, with an extract from proceedings of the board of managers covering the action of the board thereon and the final resolution adopted by the canal committee. The purpose of the board in referring the original resolution back to the canal committee was that if our exchange volunteered to your board any communication on the subject it should make a strong effort to meet the conditions to your requests as contained in paragraph 14 of your letter of August 30 addressed to Mr. Welding Ring. During the debate in the canal committee over the adoption of the final resolution, I understand that one or two members referred to the fact that a ship canal from New York to Philadelphia would have a tendency to deprive New York of one of the great advantages it will gain through the completion of the new barge canal by the State of New York. New York now suffers from a railroad differential against it in favor of Boston, Philadelphia, Baltimore, and other competing grain export ports, and the advantage we will gain by the completion of the new barge canal will tend to put New York on an equality with those competing ports, and the thought in the minds of the debaters was that New York would simply lose one of the very advantages for which it built the barge canal if this new intracoastal canal makes it possible for the competing ports to utilize the barge canal against us.

These statements in debate are the only justification for the impression you evidently have received. The matter was originally brought before us by Mr. Welding Ring, who turned over to me your letter to him dated August 30, which, because of its general character, invited action by our exchange, and the results were communicated to Mr. Ring at his request.

Very respectfully, yours,

E. R. CARHART, *President.*

Col. W. M. BLACK, *Corps of Engineers.*

[Resolution adopted at a meeting of the committee on canals of the New York Produce Exchange held Nov. 14, 1910.]

Resolved, That the committee on canals report to the board of managers that they are unable to find data on which to base the information desired by Col. Black.

[Extract from proceedings of board of managers at a meeting held Nov. 3, 1910.]

Report of canal committee embodying a resolution favoring the construction of proposed inland canal across the State of New Jersey to connect New York Harbor with the Delaware River as outlined in communication of Col. W. M. Black, of the Engineer Corps, United States Army, was read, and on motion the matter was referred back to the canal committee for further consideration and definite answers to the requests made by Col. Black.

[Resolutions adopted at a meeting of the committee on canals of the New York Produce Exchange held Oct. 27, 1910.]

Resolved, That the committee on canals favor the construction of a sea-level canal across the State of New Jersey, connecting the harbor of New York with the Delaware River. The dimensions to be not less than 18 feet depth of water and having a bottom width of not less than 125 feet; in accordance with one of the estimates made in Col. Black's letter dated August 30, 1910.

Be it further resolved, That the committee on canals respectfully request the adoption by the board of managers of a resolution of similar import and that it be sent to Col. W. M. Black, Corps of Engineers, United States Army, senior member of the board.

NEW YORK PRODUCE EXCHANGE,
New York, February 7, 1911.

DEAR SIR: Referring to your several communications in connection with the proposed canal to connect the harbor of New York with the Delaware River, we have

been giving this matter very considerable attention and study in order to arrive at a fair consideration as to its requirements for commercial purposes.

The New York Produce Exchange has always gone on record as favoring all methods of water transportation, and particularly those by canal, believing that this is the cheapest method for transportation of bulk products, and that it has a strong influence in the matter of freight rates charged by the railroads.

The New York Produce Exchange very early advocated the building of the New York Barge Canal from Buffalo to Albany, which is now under construction, and which we anticipate will be completed in 1914 or 1915. With this great work finished, there is no doubt we will again see a much larger volume of trade coming by water than at the present time. The West will avail very largely of this improved means of transportation, and with the much larger barges that will be operated on the canals the cost of transportation will be correspondingly reduced.

In your letter you have asked us various questions that we find it impossible to answer with any definiteness. We have gone through our statistics showing volume of produce handled by the Erie Canal and the portion that comes to New York, and while this is large, the total for 1910 being over 3,000,000 tons, a large portion of which reached this city, yet it is impossible for us to know how much of this traffic would pass on through the proposed canal to the Delaware River. There is nothing in our records that gives us any information or data on which to base any calculations, and it therefore must be a matter entirely of opinion and not of any certainty.

With the opening of the Barge Canal, and completion of the Seneca and Cayuga Lake Canal, we are confident that a very large trade will develop in the two items of salt and cement, and many anticipate that this will run into a million or more tons very soon after opening of the canal.

There is also a large amount of lumber which will naturally come forward by this cheap waterway route, and many of the more bulky and cheap manufactured lines in the West will seek New York over the Barge Canal.

As these same articles will be in large demand for Philadelphia and other southern ports, it is reasonable to suppose that they will be carried through by the canal barges in bulk, and supply the requirements of all places to the south of New York.

You no doubt are aware that the New York Canal is built with the expectation that barges of 1,000 tons capacity will be operated on it, and that many of these will be propelled by their own power, so that they could readily pass through the canal to the Delaware River without towage. It is our opinion that much business would be developed in the lines mentioned, and no doubt many others would also contribute.

As regards traffic coming from Philadelphia to New York, we are not in position to give any forecast of its probabilities, but there would be many lines of manufactured goods that would seek this method of transportation. As the proposed canal would pass through New Jersey, it would develop many industries along the line of the canal, and these would furnish traffic to move in both directions.

We have noted your views that you consider a canal with a depth of 12 feet and a width of 125 feet would meet the requirements of traffic, at least for a long period, and it is our view that a canal of this size would be amply large for any trade that might avail of it. This, however, is an engineering problem that you can best judge of, though in view of the size of the New York Barge Canal we believe the one proposed for the Delaware River would be as large as necessary for any traffic that might come from the West and down the Hudson River.

There will also be a large volume of trade moving through Long Island Sound, and, we think, very considerable originating in New York and Brooklyn that will be ready to avail of the cheaper transportation by canal to Philadelphia and the South. Just how great this will be is beyond our power to estimate, but the volume will be large.

We are very much impressed with the idea that it is wise to have a complete inland waterway connecting the East with the South all along our coast. We believe, however, that work ought not to be undertaken on any section of the waterway unless there is some practical assurance that the whole enterprise will be completed. We believe further that there are other projects that ought to be completed before any work on this canal is undertaken.

Regretting our inability to give you the definite information asked for, we remain dear sir,

Yours, faithfully,

E. R. Carhart,
President.

Henry B. Herbert,
Chairman of Canal Committee.

Col. W. M. Black,
Corps of Engineers.

[Appendix C 8.]

TRENTON CHAMBER OF COMMERCE,
OFFICE OF SECRETARY,
Trenton, N. J., February 2, 1911.

DEAR SIR: We beg to submit herewith a report for the Trenton Chamber of Commerce and the Philadelphia-Trenton-New York Deeper Waterway Association on the New Jersey State Canal, these organizations representing the business interests of the city of Trenton and adjacent territory. The population of the city of Trenton, according to the recent census, was 97,655. It is a manufacturing city of great importance. The majority of these manufacturers are large shippers of high and low grade freight; therefore, we, representing these interests, are particularly interested in the project of the proposed intracoastal canal, connecting New York and Philadelphia. We must reach other cities with the least possible cost of transportation, and if we are to be a city keeping pace with the others in our commercial relations, the raw materials for our factories and the coarse-grade freights must come to us at the lowest possible costs.

We endeavor to point out in this report the commercial necessity for the canal and what advantages would be derived by the local shippers in the event it is constructed. The total tonnage for the year 1909, by official reports, in and out bound freight, was 2,269,271 tons, classified as follows:

By rail, 1,861,125 tons; by canal, 308,946 tons; by Delaware River, 99,200 tons.

The proportion of freight carried by means of water transportation, according to these figures, is 25 per cent, including, of course, both canal and river traffic. If 25 per cent of the present tonnage of Trenton is carried by means of water transportation, with inadequate facilities for handling and at a prohibitive rate, it is safe to assume that a large proportion of the remaining 75 per cent of the total tonnage of Trenton now carried by rail will be carried by water, with improved water transportation facilities, namely, the completion of the 12-foot channel in the Delaware River and the proposed intracoastal canal.

As evidence of this, we present herewith a report submitted at the request of the senate investigating committee of the New Jersey Legislature by the Trenton Chamber of Commerce. This report gives a summary of the result of a postal-card canvass conducted by this organization, and have been entered on the official records of the committee authorizing the same.

REPORT OF POSTAL-CARD CANVASS MADE BY THE TRENTON CHAMBER OF COMMERCE FOR THE SENATE INVESTIGATING COMMITTEE OF NEW JERSEY STATE LEGISLATURE ON THE DISUSE OF THE DELAWARE & RARITAN CANAL.

On March 7, 1910, we mailed 250 return postal cards to all of the shippers in Trenton, including manufacturers, wholesale and retail merchants, which read as follows:

"DEAR SIR: In order to ascertain the true existing conditions pertaining to the disuse of the Delaware & Raritan Canal and the causes thereof, we are submitting for your approval the list of questions on attached card, which we trust you will answer and return not later than March 15, 1910."

The questions on the return postal card were as follows:

1. Do you ship by the Delaware & Raritan Canal?
2. If not, why not?
3. Would you ship by this canal with a lower rate?
4. Would it be as convenient for you to ship by water as by rail?
5. Has there been any discrimination in rates to your knowledge?

The number of cards returned was 100. To the first question 70 replied in the affirmative and 30 in the negative.

In answer to question No. 2, "If not, why not?" 7 replied because the rates were too high; 20 replied that it was not convenient to ship by canal; 3 replied that on account of poor service, which could not be depended upon, they could secure quicker delivery of merchandise by rail; 1 merchant replied because it was 50 years behind the times; 1 manufacturer claimed that the transfer charges were prohibitive; another manufacturer stated that they did not use the canal because they could not make connections in New York with railroad; 3 potteries suggested that the freight should be received near Mulberry Street, as formerly, so that all East Trenton firms could then use the canal to advantage.

To question No. 3, "Would you ship by this canal with a lower rate?" 80 replied in the affirmative, 15 replied in the negative, 3 replied that with proper connections at New York end they would use the canal; 1 manufacturer replied "Yes, if transfer to

other lines at either end could be made advantageous;" 3 manufacturers replied, "Yes, if there was a dock at East Trenton."

To question No. 4, "Would it be as convenient for you to ship by water as by rail?" 75 replied that it would; 25 replied that it would not be.

To the last question, "Has there been any discrimination in rates to your knowledge?" 97 replied that there had not been to their knowledge; 1 manufacturer replied, "No definite information;" 2 merchants raised the question; 1 manufacturer answered, "Yes."

Another example which proves the necessity of some relief from the present congestion of freight on the railroad is submitted:

A postal-card canvass conducted by the Trenton Chamber of Commerce some years ago shows delays in shipments. These postal cards are submitted in their original form, of which there are about 800, and fully testifies to the inadequacy of transportation at the present day.

Conditions since this canvass was conducted have not changed, and the clipping from the Trenton Evening Times of December 29, 1910, which is attached hereto, describes very emphatically present conditions.

During the month of September we received a communication from Col. William M. Black, senior member of the Board of Army Engineers, in charge of the survey for the intracoastal waterway.

Recently we also received a communication from the committee on traffic of the proposed intracoastal canal, of which you are the secretary, for the direct purpose of gathering necessary data and statistics to show and impress upon Congress the necessity of this project.

Owing to the position that the city of Trenton and vicinity occupy and the distance from the proposed canal, at first it seemed a difficult problem just how to reply to these communications and to show the benefits that could be derived from this development. After an interview with Col. W. M. Black on this perplexing problem we have learned that the benefits of the city of Trenton will come through additional links that have already been considered by the engineer in charge, and it will be permissible for us, in estimating the benefits to be derived, to take into consideration that a spur from the main canal should be considered coming into East Trenton with the establishment of an artificial basin of sufficient size to accommodate the commerce. We can also estimate our advantages with the development of the Delaware River from the outlet of this canal at Bordentown to the Pennsylvania Railroad bridge at Trenton.

The surveys, favorable reports, and action have already been taken up by Congress in the appropriation of $260,000, up to date, for the improvement of this link to a depth of 12 feet. We can further anticipate that as this proposed canal will carry a depth of at least 18 feet of water, and with only 4½ miles from the proposed municipal docks at Trenton, it is probable and quite possible that with this development the front of the city of Trenton will carry at least the same depth of water, 18 feet, as the proposed canal.

It will also be permissible, the route having already been surveyed and found practical, to develop the Delaware & Raritan Canal to the same depth with tidewater to a point where the main line of the Pennsylvania Railroad crosses under it. Another fact that is practical and possible and has been taken into consideration for the future growth and better regulation of the traffic in the city of Trenton is that it is possible to abandon the Delaware & Raritan Canal from a point where the main line of the Pennsylvania Railroad crosses under it to a point where the proposed basin from the first link of the main canal has been suggested. With this portion of the Delaware & Raritan Canal eliminated you can readily see the great benefits and improvements that would come to Trenton, as it is generally conceded that the traffic on the streets in Trenton, by railroad crossings and canal bridges, is delayed at least an hour or more every day. With this change, these obstacles can all be overcome by the depression of railroad tracks and elimination of drawbridges through the heart of the city; and, with the abandonment of the feeder, grade crossings and drawbridges running westerly would also be overcome, and the question of additional railroad freight terminals so much desired would be solved. These facts alone should carry sufficient weight to arouse enthusiasm sufficient to do all that might lie in our power to bring about these conditions for the future betterment of the city.

We strongly advocate not only the construction of the New Jersey Ship Canal and the development of spurs to reach into Trenton, but we believe that with this development and the carrying out of the entire intracoastal waterway scheme this canal will carry more commerce in one year than the Panama Canal will carry in 10 years. The time of boats plying between New York and Philadelphia will be reduced by hours.

We have made repeated efforts in trying to assist the committee in getting the manufacturers and shippers of Trenton and vicinity to cooperate in furnishing data, tonnage, and other necessary information that is essential to show the need of this development. But, we have only met with partial success in bringing out this data owing to the fact that the average manufacturer is so overburdened with details pertaining to his own business and the many applications of a similar nature being presented to them from various sources from time to time, and the magnitude of the questions that have been put to them, that in their busy hours it looms up like a great undertaking, and their general complaint is that for want of time and more general knowledge on the questions, they fail to respond.

In many cases we find where manufacturers are located along railroad sidings there is an impression that they would be antagonizing the railroads in uncovering any of their business. The excuse in this community that is often made by large manufacturers closely identified with railroad interests is that the fact that the railroad gives them such modern service by bringing carloads right into their factories that they see no particular advantage in the development of the waterways; but, as a matter of fact, in the city of Trenton, we believe the statement would be conservative to say that eliminating the coal tonnage, which is quoted at approximately 400,000 tons annually by one of our largest coal dealers, fully 50 per cent of the total tonnage of Trenton is hauled away from railroad and boat terminals by horses and wagons. To further verify this statement I have in my possession a letter from one of the largest express men in Trenton, who says that after careful investigation of same he finds there are about 950 teams employed for the hauling of freight to and from all the terminals in this city.

With this perfect development of the inland waterways and artificial cuts throughout the entire United States the benefits that are bound to come to this community could hardly be estimated. The city of Trenton consumes about 50,000,000 feet of lumber annually which is shipped here by rail, principally from the South, and the railroad rate from Norfolk to Trenton is $4.50 per thousand feet. It is estimated that with improved water facilities lumber could be brought from Norfolk to Trenton by barges at a rate of $1.85 per thousand feet, which would produce annually a saving on a million feet of lumber of over $106,000.

The question of rate on coal to the city of Trenton is rather a serious one, and there is no doubt in our minds that with the development of these waterways, it will be reasonably fair to assume that the present rate will be considerably reduced. The present average rate on anthracite coal to Trenton is $1.75. This rate would be lowered to the extent that Trenton would then secure a rate more in proportion with Perth Amboy, 57 miles farther away from the mines, which is $1.80, and New Brunswick, 27 miles farther away from the mines than Trenton, of $1.80. And, with these conditions established, the saving to the coal consumers of the city of Trenton should be at least $200,000 annually. The same discrimination exists on a great many other products that are used extensively in this manucfaturing community; and, without going further into the details we believe that with these additional transportation facilities the savings to the city of Trenton would approximate over a million dollars annually.

There is no doubt whatsoever but that the rate on soft coal from the South would be considerably less than it is at present.

In 1909 the Legislature of the State of New Jersey passed an act conferring upon minicipalities the authority to organize harbor boards, issue bonds and to acquire water front property by purchase or condemnation for the erection of docks and other facilities. A copy of this act is as follows:

[Senate No. 126. State of New Jersey. Introduced Feb. 15, 1909, by Senator Harry D. Leavitt. Referred to committee on commerce and navigation.]

AN ACT Authorizing the creation of harbor boards in cities accessible to commerce by water and prescribing their powers and duties.

Be it enacted by the Senate and General Assembly of the State of New Jersey:

1. In any city of this State accessible to commerce by water there may be created a board to be known as "The harbor board of Trenton" (naming the city), by the adoption of a resolution by the board or body having charge of the finances of any such city. Such board shall be appointed by the board or body having charge of the finances in any such city.

2. Such board shall consist of four reputable citizens of such city, of undoubted character, who shall be chosen with a view to business skill and efficiency. No more than two members of said board shall belong to the same political party. The members of the first board so as aforesaid appointed shall hold office one for a term of one year,

one for a term of two years, and one for a term of three years, and one for a term of four years, and the members thereafter appointed shall hold office for a term of five years and until their successors are appointed, as aforesaid, and qualified. Members of such boards shall qualify by taking such oath as shall be required by the municipal charter for other municipal officers, or if no oath is required by charter, then by taking an oath faithfully and impartially to perform the duties of their office.

3. The board shall have power to elect a president, to employ a secretary, who shall not be a member of the board, and such other officers or employees as may be necessary, as well as a marine engineer and a harbormaster, each of whom shall perform such duties as may be assigned by the board under the direction of the board, and the board shall, subject to appropriation for that purpose from the funds of said city, fix their respective salaries.

4. The board shall have power to make rules and regulations for its own government and for the regulation of the use of the harbor or river front of the said city by commerce, and the use of the public docks, wharves, piers, and warehouses of the said municipality, and to enforce the same; to obtain and make leases of docks, wharves, piers, and warehouses, and receive the rents and income thereform, and pay the same over to the proper fiscal officer of such municipality, out of which said board may expend such sum for the purposes of carrying out the provisions of this act as the board or body having charge of the finances in such municipality shall appropriate; to make plans for the improvement of the harbor or river front of the said city, the construction of docks, wharves, piers, warehouses, sea walls, retaining walls, bulkheads, and the like, and for the deepening, clearing, widening, and protection of the harbor or river front and the maintenance thereof; to buoy and light such harbor or river front free from obstructions dangerous to navigation, and to do any similar act advantageous to the safe and profitable use of the said harbor or river front by commerce, and the development of the water commerce of the said municipality.

5. The said board shall have power to purchase, or otherwise acquire, or to condemn in the name of the said city, according to an act of the legislature entitled "An act to regulate the ascertainment and payment of compensation for property condemned, or taken for public use" (revision), approved March 20, 1900, and the amendments thereof and supplements thereto, any lands on the water front or the said harbor or river necessary for the improvement of the said harbor or river front, the construction of docks, wharves, piers, warehouses, sea walls, bulkheads, driveways, and the like, as well as riparian lands, when authorized so to do by the board or body having charge of the finances of said city, subject to appropriation of municipal funds for such purpose, and to improve the same.

6. No contract for any improvement or construction shall be entered into or work begun thereon until plans and specifications therefor shall have been prepared and approved by the board and submitted to and approved by the board or body having charge of the finances of said city, and bids invited and received thereon after advertisement in two or more newspapers of general circulation for a period of 10 days, nor until appropriation for the whole or part thereof shall have been made therefor.

7. The board or body having charge of the finances of any city creating such a harbor board shall have power to raise funds for the purpose specified in this act by the issue of bonds or otherwise, subject to the laws of this State governing the amount of bonded indebtedness of such municipalities.

8. No member of the said board, nor any person appointed to office under this act, shall be financially interested in any contract, bargain, sale, or agreement made by or on behalf of the said board, nor in any matter or thing connected therewith, and any contract, bargain, sale, or agreement made in violation hereof shall be void as to the said board and the municipality represented by the said board.

9. The board shall meet at least once in each month and as often in addition thereto as may be necessary. Three members of such board shall constitute a quorum for the transaction of any business properly coming before said board; provided, however, that notice, in writing, of any matter to be acted upon at any special meeting of said board shall be set forth in the notice of said special meeting, and no other matter except such as is specified in the said notice shall be considered by said board at any such special meeting.

10. The board shall, as often as requested, report to the council or other board or body having charge of the finances its proceedings, any work that may be under way, and its progress, the general condition of the harbor front, and any other matters pertinent to the work and purposes of the said board and the development of the commerce by water of the said municipality.

11. All acts and parts of acts inconsistent herewith are hereby repealed and this act shall take effect immediately.

An amendment to this act was passed giving cities the power to place streets adjacent to water fronts under the control of harbor boards for the purpose of seeking cooperation with the city of boats, steam railroad and electric railway companies and to place terminal facilities under the absolute control of the municipality. Trenton took advantage of the first act by the appointment by the city council of a harbor board. This board, immediately upon organizing, employed an expert engineer, Mr. Joseph F. Hasskarl, of Philadelphia, Pa., to prepare comprehensive plans for water front improvements for the city of Trenton. These plans were adopted by the harbor board and copies sent to the United States War Department for its approval.

On February 15, 1910, city council of Trenton authorized the harbor board to acquire by purchase or condemnation the river front for harbor improvements. On January 21 of the same year council passed an ordinance providing for an immediate bond issue of $50,000 and $50,000 more to be given when required for the purchase of our entire water front at tidewater.

Trenton does not intend to improve all her water front at the same time. Our policy is to improve the water front from time to time as increased commerce shall demand. The financial policy covering this work is that to meet a total cost of about $1,000,000 the city shall appropriate $100,000 annually for 10 years—the period in which the entire improvement can be easily completed under the plans already adopted by the harbor board.

We herewith submit a complete set of blue prints showing the proposed improvements to the water front of Trenton as well as a report and estimate of the cost as furnished by the engineer.

RESOLUTION.

Resolved, that the harbor board of the city of Trenton be and it is hereby authorized to purchase, or otherwise acquire, or condemn in the name of the city of Trenton, in conformity with an act of the legislature of this State entitled, "An act to regulate the ascertainment and payment of compensation for property condemned or taken for public use" (revision of 1900), approved March 20, 1900, and the amendments and supplements thereto, and the lands included in the schedule annexed to this resolution, or such part thereof, as such board may in its discretion deem necessary for the improvement of the harbor of River Front, the construction of docks, wharves, piers, warehouses, sea walls, bulkheads, driveways, and the like, as well as riparian lands; and for so doing the passage of this resolution shall be their sufficient warrant.

I hereby certify that this is a true copy. Adopted, Trenton, N. J.

C. A. Remsen,
Assistant City Clerk.

Adopted February 15, 1910.

Harry B. Salter,
City Clerk.

Mr. Wilfred H. Schoff,
Philadelphia, Pa.

Philadelphia, Pa., *February 7, 1910.*

Gentlemen: I have the honor to submit herewith a plan, showing a bulkhead and pierhead line in the Delaware River, in front of the city of Trenton; also a number of piers and general plan of harbor improvements.

Owing to the limited time for the preparation of this plan, and the extraordinary severity of the winter, a more thorough examination and survey of the locality could not be made; consequently, the plans are not as elaborate and complete as I intended, and as otherwise would have been the case.

I am fully aware that the present conditions and needs of the city of Trenton do not make it necessary to enter immediately into improvements on such a large scale as I have shown and suggested; but my idea is to prepare and have adopted by the city of Trenton a comprehensive plan, providing for present requirements and future expansion and development of the city of Trenton. My thought is, for the present, that the city should simply acquire the land as rapildy as means will permit, in order to get control of the water front, and then build piers and bulkheads as required. The acquirement of the land at this time is of the greatest importance.

I have given careful consideration to the proposed bulkhead and pierhead line, and believe that, if you should request the Secretary of War to establish a pierhead and bulkhead line at Trenton, and submit the plan I have prepared showing such lines, and request to have them adopted, your application would receive most favorable consideration.

In connection with the pierhead and bulkhead line as fixed by me on the chart I would suggest that, when you present this matter to the War Department, you invite attention to the cross sections (five in number) that I have shown and computed in different parts of the river, in which I show present conditions, and that they will be after the proposed improvements are made. Those cross sections show conclusively that the line as fixed by me will not in any possible way injure the river and provides for a free run off of freshets.

It is thought that by the time the proposed improvements are found too small or inadequate the city will have the means and find it advantageous to extend the system of harbor improvements to the section of the city below the cemetery, and I would urgently recommend that the purchase of such lands be made at an early date, while they can be bought at comparatively low figures.

From my understanding of the present financial condition of the city of Trenton, and the money available for the use of the harbor board at this time, it appears to me that the herewith submitted plans, data, and report are all that you require at the present time, or will require until after you have purchased lands, and more money is appropriated for the actual improvement of your harbor.

The plans I have prepared are as follows:

Piers No. 1 and No. 2.—For river commerce and passenger service. Length, 450 feet; width, 100 feet. With sheds and single railroad track, designed to carry a weight of 450 pounds per square foot of deck space. Estimated cost of each pier, $104,300.

Pier No. 3.—For coastwise traffic. Length, 650 feet; width, 100 feet. With shed and single railroad track, designed to carry a weight of 450 pounds per square foot of deck space. Estimated cost, $149,330.

Pier No. 4.—For coastwise and trans-Atlantic trade. Length, 555 feet; width, 150 feet. Double-deck, two railroad tracks, designed to carry 450 pounds per square foot on the first or lower deck and 350 pounds per square foot on the second deck. Estimated cost, $269,003.

Pier No. 5.—For low-grade freights, iron ore, coal, sand, gravel, etc. Length, 465 feet; width, 100 feet. Open single-deck pier, paved with Belgian block, single railroad track, designed to carry 500 pounds per square foot of deck space. Estimated cost, $71,854.

Pier No. 6.—For low-grade freights, iron ore, coal, sand, gravel, etc. Length, 370 feet; width, 100 feet. Open single-deck pier, paved with Belgian block, single railroad track, designed to carry 500 pounds per square foot of deck space. Estimated cost, $57,616.

The dock spaces between piers are in no case less than 150 feet.

The plan shows an extensive line of bulkhead. Of course, this will not be necessary until commerce or other improvements demand it. The plans of the bulkhead show recess landings every 500 feet, which, I think, will prove a great convenience for landing small boats, launches, etc. The approximate cost per hundred feet of an average section of bulkhead is $6,794.

These plans have been examined by a number of experts in the line of harbor improvements and have been pronounced good and adequate, as they provide for all your present needs and future requirements.

In the preparation of the plans herewith submitted I took into consideration the present and future size and conditions of Trenton, the improvements in the Delaware River, which are now contemplated and will surely be made between Philadelphia and Trenton, also the local conditions along the shores and in the river, in the vicinity of Trenton, and was guided by a desire to take full advantage of all natural conditions.

Trusting the information will be of service to you, I have the honor to be

Very respectfully, yours,

Joseph F. Hasskarl.

Mr. Frederick W. Donnelly, president, and members of the Harbor Board of City of Trenton, Trenton, N. J.

Inclosed are the following:

Sheet No. 1.—Showing survey made of Delaware River in the vicinity of Trenton, the latter part of 1909.

Sheet No. 2.—Showing soundings in the Delaware River, contours, cross sections, and proposed improvements.

Sheet No. 3.—Showing proposed improvements.

Sheet No. 4.—Showing plans of all the piers and the bulkhead.

On Tuesday, September 27, 1910, a conference was called at the statehouse, under the auspices of the Philadelphia-Trenton-New York Deeper Waterway Association,

the purpose of which was to formulate some plan of action by which the cooperation of the various interests in New Jersey could be secured to promote the New Jersey Ship Canal. At this conference the various commercial organizations and business interests of the State of New Jersey were represented, and Col. Black, of the United States Engineers Office, having under its supervision the proposed project, was present and described the character of the proposed canal and the approximate cost of several types of canals, and gave other interesting data pertaining to the same.

The following resolutions were offered and unanimously adopted:

"*Resolved*, That the governor of this State be requested to appoint a committee of 5 to cooperate on behalf of this State with the committee of 50 in connection with the New Jersey Ship Canal and the development of the inland waterways.

"*Resolved*, That the governor and the legislature of this State be requested to pass an act for the appointment of a commission with proper powers to secure rights of way across the State of New Jersey for ship canal, with a view to deeding the same to the National Government. Resolved, further, that the governor and legislature of this State be requested to favor an appropriation for this purpose."

At the request of the Philadelphia-Trenton-New York Deeper Waterway Association, Governor Fort recently appointed a commission composed of David Baird, of Camden, N. J.; Peter Campbell, Newark, N. J.; Samuel Heilner, Spring Lake, N. J.; Benjamin F. S. Brown, Natawan, N. J.; and Frederick W. Donnelly, of Trenton, N. J. The commission met for organization at the statehouse on Thursday, January 12, and adopted the following resolutions:

"*Whereas*, at a meeting of the Philadelphia-Trenton-New York Deeper Waterways Association, held at the statehouse, in the city of Trenton, it was resolved that the governor of this State be requested to appoint a committee of 5 to cooperate on behalf of this State with a committee of 50 of the Atlantic Deeper Waterways Association to consider and report upon matters in connection with a proposed cooperation between the State of New Jersey and the Federal Government, looking toward the construction of a ship canal across New Jersey and the development of the inland waterways of this and other coast States, in accordance with which resolution the governor did appoint Messrs. David Baird, Peter Campbell, Samuel Heilner, Benjamin F. S. Brown, and Frederick W. Donnelly as the members of such commission; and

"*Whereas*, the said commission has met from time to time to discuss the matters submitted in accordance with the said resolution, and has received such information as could be afforded by the Federal Government with reference to the survey made by the engineers of the United States Army in such detail as the same is now perfected; and

"*Whereas*, it is apparent that in order to bring about the undertaking of this important work by the Federal Government cooperation by the State of New Jersey is necessary and proper, since such cooperation on the part of the State is better to induce the Federal Government to undertake the construction of this canal; and

"*Whereas*, It is believed by the commission above referred to, upon information received from the Chief of Engineers of the United States Army, under whose direction the said survey was made, that the right of way of the said canal, according to the survey made, will require about 4,000 acres of land, the cost of which, including damage claims for water rights extinguished, is estimated to be about $500,000, and

"*Whereas*, It is believed that the benefits which will accrue to the State of New Jersey by reason of the construction of the proposed canal are a sufficient warrant for the cooperation of the State with the Federal Government in the construction of the said canal:

"*Be it resolved by the Senate and General Assembly of the State of New Jersey:*

"1. That the construction of a canal across the State of New Jersey, connecting New York Bay with deep water in the Delaware River at Bordentown, N. J., by the Federal Government, is an enterprise which is likely to result in great benefit to this State and its inhabitants, in encouraging the various industries of the State, and affording a more ready method of communication and transportation between points within this State and other points in this country and abroad, particularly in view of the importance of this canal as a necessary link in the intracoastal system of inland waterways extending from Maine to Florida, which, when completed, will be of inestimable benefit to transportation along the entire Atlantic seaboard.

"2. That in order to bring about the construction of this canal and its completion within as short a time as possible, on behalf of the people of this State it is hereby declared that when the Government of the United States shall finally settle upon the route of the said canal and shall make provision for its construction by suitable appropriation, the State of New Jersey shall acquire the right of way for the said canal by purchase or condemnation from the owners thereof and cede the same to the Federal Government for the uses of the Government in constructing and maintaining the said canal, upon condition that the said canal, when completed, shall

be free and open to the commerce of the world, without tolls or charges for the passage of vessels or freight thereon; provided the said right of way can be obtained by purchase or condemnation for a sum not exceeding $500,000, or such sum as may be appropriated by the legislature for that purpose at the time when such appropriation and other legislation necessary to carry into effect the purposes of this resolution, shall become necessary and appropriate.

"3. That a certified copy of this resolution be forwarded by the secretary of the senate to the honorable the Secretary of War.

"4. This joint resolution shall take effect immediately."

It has been suggested and favorably commented upon by the press of the State that in addition to providing the right of way for the ship canal, that the State acquire from 500 to 1,000 feet on each side of the canal for the purpose of terminals, manufacturing sites and railroad connections to be leased under State control, and the income from the same to be dedicated to the road fund of the State.

It has further been suggested in connection with this development that the State, during the process of the construction of this canal, construct an automobile highway following the line of the canal from the Raritan Bay to the Delaware River.

New Jersey's proposed assistance in the development of a ship canal and Trenton's plan of municipal control of its water front and streets adjacent thereto, are solutions of the water transportation problem that have been set up; and these solutions lead logically to the perfect plan of cooperation of the railways and waterways.

New Jersey and Trenton propose to dovetail the waterways and railways. We are going even further; we propose to include in our development the other highways; and this dovetailing will come about either by common consent of all parties at interest or by force of law. The modern railroad man now sees the wisdom of this policy, and their cooperation, I believe, is already assured.

It is the consensus of opinion among those who have given study to the project that the construction of such an intracoastal canal across the State of New Jersey holds out advantages immeasurably superior to the amount of money required for its construction, and it is the earnest hope of all, that the project can be so presented to Congress as to bring about the making of an appropriation sufficient for the carrying out of the project.

Respectfully submitted.

C. ARTHUR METZGER,
Secretary of Trenton Chamber of Commerce.
FRED'K W. DONNELLY,
President Philadelphia-Trenton-New York Deeper Waterway Association.

[Appendix C 9.]

THE BOARD OF TRADE OF THE CITY OF NEWARK, N. J.,
January 6, 1911.

DEAR SIR: With reference to proposed intracoastal canal project and information requested in yours under date of October 25, 1910, we beg to submit:

1. The manufacturing interests in the city of Newark have felt the great necessity of municipal dock facilities. The wharf owned by the city has a frontage of about 200 feet, as poorly located as possible and seldom available.

The city, however, under a referendum vote has authorized a bond issue of $1,000,000 to be used in acquiring all of the available frontage on Newark Bay to be developed under municipal direction for water and terminal purposes, in connection with waterway improvements contemplated on the meadow lands adjacent thereto, which work is being urged by the mayor, and options on lands are being secured.

2. It is the purpose of the city to have the system of wharves and terminals connected with the following railway lines: The Pennsylvania, the New Jersey Central, and the Lehigh Valley.

3. All of the available frontage on the Passaic River is occupied by private corporations. A privilege to manufacturers or others who wish to unload a cargo at various times is granted.

6. As to the area and population receiving benefits of water transportation, this would include the entire city of Newark, the West Hudson towns, Belleville, and points adjacent thereto, an area of about 40 square miles, having a population of about 500,000.

7. Freight rates by rail are as follows, in cents, per class per hundredweight between Philadelphia and New York:

1	2	3	4	5	6
22	18	15	12	10½	9½

Between Philadelphia and Newark, the same as above.

9. In and about this city there are not less than 16 freight terminal stations, placing such facilities within a mile of almost any point, according to the railroad on which delivery is to be made.

There are five central terminals within a mile of the heart of the city.

10. Cost of haul would be about equal from river points to that from railway terminal points.

12. Total freight delivered in Newark by rail, 3,670,738 tons.

Shipped from Newark, 1,047,489 tons.

Tonnage received and shipped by water, 2,778,062 tons.

Estimated value of river freight, $137,745,000.

Number of trips made annually by vessels to and from Newark, 36,560.

13. The volume of bulk freight delivered by water consists of lumber, brick, paving materials, ores, fertilizer materials, and gypsum rock.

A larger percentage of lumber is now coming in by rail to that of former years, owing to the point of origin not being located at points where water deliveries can be made without rehandling. Owing to the practical abandonment of the Morris Canal, which is now operated by the Lehigh Valley Railroad Co as lessees, the greater volume of the tonnage of coal consumed in this city and vicinity is now delivered by rail, with a consequent additional cost.

Further, with reference to the benefits which would follow the construction of such a canal as proposed to connect New York Bay and the Delaware Bay at Philadelphia, and consequent upon the extension of such an inland water route to connect the Delaware and Chesapeake, there should be an immediate reduction in delivery charges, owing to the risk of hazard to vessel and property being largely removed.

The terminal facilities in and about Raritan Bay, Arthur Kill, and Newark Bay are subject to a splendid development both for water and railway terminals, and this development should lend itself to effecting a great saving in the annual fixed charges now paid for lighterage service in and about New York Harbor and a quicker delivery of freights by affording larger facilities at termini, if the advantages were available for vessels engaged in the ocean-carrying trade and railway terminals adjusted therewith.

An inland route such as proposed would take practically all of the coastwise trade originating at extreme points and would undoubtedly stimulate the building up of communities along the entire route, particularly that part of it within the State of New Jersey.

It would not only encourage larger development of farm properties by affording facilities for the transportation of produce to the great centers of population and to points along the route, but it would undoubtedly bring about what is known as intensified farming and market gardening, as the section through which it is proposed this canal should run is subject to such development, the land being perhaps the most fertile of any in this State.

It would build up new industries along the route and would serve to expand the manufacture of tile products from clay, and establishment of glass plants, and the shipment of sand in vast quantities for construction uses.

It would also be made use of, undoubtedly, in connection with the great tonnage which will come from the Lake districts through the barge canal via the Hudson for direct transport to Philadelphia for transshipment.

It is the consensus of opinion among those who have given study to the project that the construction of such an intracoastal canal across the State of New Jersey to connect the Hudson with the Delaware holds out advantages immeasurably superior to the amount of money required for its construction; and it is the earnest hope of all that the project can be so presented to Congress as to bring about the making of an appropriation sufficient for the carrying out of the project.

Respectfully submitted on behalf of the Board of Trade of the City of Newark.

George F. Reeve,
President.
Jas. M. Reilly
Secretary.

Col. W. M. Black,
Corps of Engineers.

[Appendix D 1.]

Chesapeake & Delaware Canal Co.,
Philadelphia, June 14, 1910.

Dear Sir: In response to your letter of the 13th instant, making inquiry in regard statement of cost of the Chesapeake & Delaware Canal in our exhibit, marked "A."

dated August 31, 1906, I would say that, so far as we have been able to ascertain, the amount, $3,989,365.17, represents the cost of the canal to May 31, 1887. Since that date no renewals or betterments made have been added to that account.

Very respectfully,

C. L. NICHOLSON, *President.*

Maj. R. R. RAYMOND,
Corps of Engineers.

[Appendix D 2.]

CHESAPEAKE & DELAWARE CANAL CO.,
Philadelphia, July 12, 1910.

DEAR SIR: We are in receipt of your letter of the 11th instant, requesting that your board of officers, appointed under the provisions of the river and harbor act of March 3, 1909, to survey an intracoastal waterway between Boston, Mass., and Beaufort, N. C., be furnished with a price at which our company will sell to the United States our property known as The Chesapeake & Delaware Canal, together with its franchises, etc., as it exists to-day.

It is not practicable for us to carry out your suggestion; there are approximately 900 stock and loan holders of the company, to perhaps most of whom such a proposition, to bring a definite response, would have to be accompanied with some price that might probably be obtained for their securities if negotiations pending eventuated in an agreement of sale.

In the report of the commission appointed to examine and report upon a route for an open waterway to connect the Chesapeake and Delaware Bays, Senate document No. 215, Fifty-ninth Congress, is given an itemized statement of the canal company's estimated value of the physical canal and its appurtenances at that date, amounting to $5,348,071, which may, perhaps, in some measure meet your requirements.

Very respectfully, C. L. NICHOLSON, *President.*

Maj. R. R. RAYMOND,
Corps of Engineers.

[Appendix D 3.]

BALTIMORE & PHILADELPHIA STEAMBOAT CO.,
Philadelphia, January 31, 1911.

DEAR SIR: In reply to yours of the 26th instant I herewith return the report which I have filled up as covering our business through the Chesapeake & Delaware Canal. As to the amount of tonnage that would use this canal if enlarged, in my judgment it would be very great in both directions. All east-bound vessels would use the canal or inside route to save the sea risks via Cape Henry. A great deal of trade would use the canal via Cape May to and from the East, which would save them from the long haul and sea risk. The present canal is in a deplorable condition as well as unreliable in operation. The rates charged for toll are prohibitory, restrict trade and prevent competition.

Yours truly, F. S. GROVES, *Agent.*

Maj. R. R. RAYMOND,
Corps of Engineers.

RIVER & HARBOR IMPROVEMENT CO.,
Philadelphia, January 31, 1911.

DEAR MR. MILLER: Inclosed please find a list of our plants which would use the Delaware & Chesapeake Canal if enlarged to a 35-foot width. I trust the same is in the form you wish. The annual saving such a canal would be to us is hard to estimate as it would permit us taking our plant to points inaccessible at present except by taking the risk of an outside tow.

The saving might perhaps be estimated at from $5,000 to $10,000 per year.

Yours truly,

RIVER & HARBOR IMPROVEMENT CO.,
JAMES D. FAIRES, *Superintendent.*

Mr. GEO. W. T. MILLER,
Assistant Engineer.

J. B. BLADES LUMBER CO.,
Newbern, N. C., March 9, 1911.

DEAR SIR: Your letter of March 7 is at hand, with circulars inclosed. I also received the first circular you sent, but was called away from home and did not get to look after it; in fact, the questions asked are a little difficult to answer.

The cut from the Delaware Bay to the Chesapeake Bay, about where the old canal is, is a most important one; yet, until the cut is made from Norfolk to our sound, I can not see that this would so greatly benefit us.

We are shipping from the various mills here that we are interested in, from fifteen to twenty million feet of lumber per year. Nine-tenths of this goes through the Delaware & Chesapeake Canal. The rate on this lumber to Philadelphia from our mills is $2.75 per thousand, and by rail it is about $5.25, so you see that the present water facilities with the saving to us is very great. Now if the waterways were made sea-level canals, free of tolls, we would not only save the amount of the toll, which is about $45,000, but we would be able to ship in larger barges, and by this means saving at least 50 cents per thousand, or $75,000. This does not take into count the mills that we are interested in at Elizabeth City, with an output of about 12,000,000 feet of lumber per year, which is all shipped almost wholly by rail, but with the improved and free waterways would move largely by water, and the amount of business done by us is only a small part of the whole amount.

We can not afford to use the part of the canal that is now completed to Beaufort, because this puts us in the ocean south of Cape Hatteras, a very dangerous coast, besides our lumber carriers are made for inland waters and would not stand the waves of the ocean. This makes a wonderful saving in transportation, because the barges being built for inside traffic do not need to be built too expensively to stand the work, and it is safe to use them almost twice as long as if they were trading in the ocean.

We do not receive any goods worth taking any account of, as we buy through the regular dealers the supplies we need. I am intensely interested in the success of this project and will be glad to do anything I can to give you information with regard to it. I am filling in one of these blanks to correspond with what I have said in the letter. If you need something more accurate and more in detail, please advise me, and we will try to give it to you.

The barges by which we make lumber shipments usually return to us loaded with coal, fertilizer, and merchandise. The merchandise shipments, with free water rate, would be greatly enlarged and I believe a regular steamer line would be established.

Yours, very respectfully,

J. B. BLADES, *President.*

Mr. GEORGE W. T. MILLER,
Assistant Engineer.

[Appendix E 1.]

STENOGRAPHIC REPORT OF PUBLIC HEARING HELD AT NORFOLK, VA., SEPTEMBER 6, 1910.

Members of board present: Col. F. V. Abbot, Lieut. Col. J. C. Sanford, Lieut. Col. M. M. Patrick, Maj. R. R. Raymond, Corps of Engineers, United States Army.

Col. ABBOT. The meeting will come to order, please. Col. Black, the president of this board, has asked me to announce this morning that emergency orders have made it necessary for him to be in Habana, Cuba, this morning.

He wants it understood that he will go over all the papers submitted, will read over the stenographic report of these proceedings, and in that way will be able to give to the facts brought out at this meeting the necessary consideration in forming his decision as to which route will be selected.

I am informed that a large delegation is expected here about 11 o'clock. I regard it as very important to bring out to-day all possible facts bearing upon the question at issue. To do that properly, I think it is necessary for the actual business of the meeting to await the arrival of this large delegation, so that they may have an opportunity of hearing what is said, and thereby have the opportunity of replying thereto if there is anything which they wish to say. We shall, therefore, take a recess until 11 o'clock, and if you all come back again at that time I will be very much obliged. We wish to get all the facts possible to-day, so in forming our final judgment on the very important matters entrusted to us we may not err. Recess until 11 o'clock.

(At the expiration of the recess the meeting was called to order by Col. Abbot, who read the act of Congress under which the present board is acting.)

Col. Abbot. We are here to-day to give this public hearing, and I ask any one who has facts to present to rise and present them, and then he will be followed by others representing the same side, and when that has been exhausted I will ask the persons representing the other side to present their cause. As you rise, please give your name to the stenographer.

Mr. M. K. King (of Norfolk). I desire to file with you some photographs that will be referred to by the people who will address you. These are industries along the line of the Lake Drummond Canal. They are designed to show that the region is one of active production. These [referring to the photographs [1]] are farms; there is a farm of 3,200 acres under cultivation; there is another of 900 acres, there is another of 1,800 acres, and there is another of 2,500 acres. There is the shipping depot of the Roper Lumber Co., which produces the raw material and manufactures it in its mill at Gilmerton. [Mr. King here presented photographs [1] showing the development of the country in the vicinity of the canal.] Here is a publication [1] which gives some illustrations of the work done on the farm of 1,800 acres, which I spoke of, in the way of drainage and improvements. I desire to file that with the others.

The statements I offer, and I shall file them, are intended to indicate the preference of traffic for the Lake Drummond Canal.

For the eight months of 1910 the receipts of tolls on the Lake Drummond Canal have increased 47 per cent.

Month.	1909	1910	Month.	1909	1910
January	$6,509	$5,284	June	3,728	6,127
February	6,408	7,160	July	3,261	6,945
March	6,970	10,329	August	3,016	7,904
April	5,167	7,327			
May	5,117	8,097	Total	40,176	59,173

For the same period the number of vessels has increased 20.4 per cent and the registered tonnage 35.5 per cent.

Month.	Number of vessels.		Tonnage.	
	1909	1910	1909	1910
January	414	406	41,453	38,814
February	405	399	38,298	45,672
March	485	531	40,979	36,220
April	386	510	36,473	50,315
May	402	525	37,954	49,307
June	413	485	29,827	48,726
July	363	549	29,041	50,287
August	330	446	24,342	37,836
Total	3,198	3,851	278,367	377,177

I desire to ask the board's attention particularly to the following statement relative to the movement in the two routes. From March 12 (when the record began) to August 31, inclusive, the movement of all vessels throughout the two waterways has been as follows, being an increase of 71 per cent and 63 per cent of total vessels in both routes:

	Currituck route.	Lake Drummond route.	Increase.
Steamboats	416	698	282
Tugs	481	620	139
Vessels (sailing)	191	409	218
Barges	103	783	680
Rafts	61	53	8
Lighters	96	81	15
Motor boats	330	228	102
Total	1,678	2,872	1,194

[1] Examined and filed by the Board, but not printed.

The steamboats represent service chiefly local in each route; the tugs are mostly hired by the canal companies; and the motor boats, many of them, are service boats.

None of these classes represents competitive traffic passing between Chesapeake Bay and North Carolina waters, which is carried in sailing vessels, barges, and lighters. Of those three classes the number passing through Lake Drummond Canal was 883 greater, and was 74.5 per cent of the aggregate of those classes by the two routes, and the tolls on vessels of 100 tons and over are 35 per cent greater in Lake Drummond Canal.

It will occur to the board that the period is the one most favorable for traffic in the Currituck Sound route. The prevalent southerly winds caused maximum stages of water, and the dangers of coastal storm is least. The traffic, nevertheless, in large preponderance sought the route where it found protection, stable maximum depth for full ladings, and greater dispatch, at higher tolls but less cost.

This fact is not to be explained away. The cause is natural and permanent; results may fluctuate at times under temporary influences; but under such supervision as that of your corps I do not hesitate to say that if both routes were free, the same or greater excess of traffic would continue to seek the western route.

The following is a comparison of registered tonnage vessels of all classes:

	1909	1910
March 12–31	28,208	38,419
April	36,473	50,315
May	37,954	49,307
June	29,827	48,726
July	29,041	50,287
August	24,352	38,056
Total	185,855	275,090
Increase	....	[1] 89,235

[1] 48 per cent.

From April 1 to September 1 the average time of all vessels moving continuously through Lake Drummond Canal was 7 hours and 5 minutes, including both locks.

We submit the testimony of 58 masters of steam and sail vessels and barges, giving the reasons of their preference for either route. The average years of service in the two routes is 13 years. (See Exhibit A attached hereto, p. 267).

One board of your corps, in considering certain projects for this section, has said that the engineering advantages and disadvantages are so nearly balanced that the question of cost may be made the determining consideration.

That is cramping this situation into deformity. The governing facts are of right and wrong, not of expediency.

Is it conceivable that if the public, that is to pay for this waterway, understood that it was proposed to build it partly out of the farms, mills, shops, and other activities of the threatened district it would accept the sacrifice? Hardly.

Again, the development of transportation in this country has been progressive. The day of small beginnings and low cost paved the way for the proportions of this day that would then have been prohibitive. This policy often mortgaged the revenue of posterity, and wisely.

In this situation, however, it is proposed to reverse the system and burden the living for the benefit of those to come.

The location and estimated cost of this section of the waterway are predicated upon future enlargements which this generation and the next may never ask for.

If the military need of the Government, or the changed and novel wants of a commerce yet unborn, demand a larger waterway, don't make its cost a servitude upon the lands and people of a part of two States only.

Is it prudent to close up any channel of transportation to commerce? Is it not the foundation of the waterways policy to expand and increase? A railroad is seldom or never abandoned. With some degree of efficiency it contributes its share of facilities to the development and maintenance of that common stock of activities that means prosperity.

The Lake Drummond Canal was performing its mission before there were railroads; it has continued to do so for 30 years after a neighboring one was built, and its mission is not ended.

Mr. W. B. Brooks, of Baltimore. Mr. Chairman and gentlemen: I appeared before this board in March, 1910, in New York City, on behalf of the Lake Drummond Canal & Water Co., known as the Dismal Swamp Canal, and at that time I made an

offer in behalf of the company to sell the canal to the Government for the sum of $2,500,000, giving a depth of 12 feet of water and locks of suitable size at either end, said locks generally conforming to the report of the engineers submitted in Document 84, Fifty-ninth Congress.

Upon request of the board to name a price at which the company would be willing to turn over the property in its present condition, under date of March 21, I wrote a letter naming a million seven hundred and fifty thousand dollars.

This board and former boards have reported in behalf of the Albemarle & Chesapeake Canal in preference to the Dismal Swamp Canal and I believe they have been guided simply from an engineering standpoint.

What is the great value of a canal? It certainly is not the engineering quality, but is the use of the same by commerce. To-day I can safely say that 75 per cent of all commerce passing from the lower sounds of North Carolina goes through the Dismal Swamp Canal in preference to the Albemarle & Chesapeake Canal. There must be some radical reason for this. When I say further that this same commerce is paying a higher rate per ton to the Dismal Swamp Canal, than is charged in the Albemarle & Chesapeake Canal, there must still be a further reason. That reason is not hard to find. It is because the Dismal Swamp Canal presents a more certain route, one that is not affected by tides or winds, in which the storm plays no part; consequently, it makes it the most safe and sure, and this point is the one which I wish to draw this board's particular attention to, and it remains for you to state which is the safest and best adapted for commerce, and which had the Government better provide for commerce?

The Government, I take it, is carrying out this inland project for the use of its people; therefore, if its people elect to follow a certain line because of its advantages, should this board turn that down because another line presents easier engineering problems? The question of a few dollars more or less on the cost, certainly ought not to control the action of this board.

It is certain that whichever route is adopted and acquired by the Government means the utter ruin of the other route, and I can readily appreciate that this board is in an awkward position in this respect, and it certainly is not my desire to make your task harder.

The reports by the engineers on this matter that I have seen base their figures on the 10-foot project, and on the 12-foot project, and in arriving at their conclusions state the number of cubic yards of excavation that would be required to produce these depths, which, at an assumed price, would cost so many dollars, and in the comparison between the two routes would sum up their decision on these figures.

If you will examine those figures, you will find that no provision has been made to maintain these depths except at ordinary tides, whereas the winds play an important part in condition of the tides in the Currituck Sound, and I think I am speaking within bounds when I say to maintain a 10-foot canal, under all conditions of tides would require at least a 15-foot cut, and if you wish a 12-foot channel it would require a 17-foot cut. This is not the case with the Dismal Swamp Canal, because the winds have no effect on the depth of the water; consequently, in making comparisons, certainly an excavation fund would be provided for more than the depth stated, and this should be added to the cost of producing the channel via Albemarle & Chesapeake Canal.

Again, in making comparisons, the figures considered have been for entirely removing the locks at either end of the Dismal Swamp Canal, and producing a sea-level canal. This is unnecessary for commerce, as is evidenced by the fact that commerce is using the locks without complaint.

The very existence of these locks means a maintenance of a uniform depth and of a certain navigation that equals in continuity land travel.

So satisfactory is this condition that I do not believe I am speaking out of bounds when I state that there is not one member of this board who would eliminate these locks, if they were under his control, if by so doing it would produce conditions that exist in our neighbor's canal during any storm period, nor do I believe that commerce would countenance such removal, if it thought it would produce a condition that now exists in the Currituck Sound.

To sum up, therefore, gentlemen, it means that if you are comparing these canals from an engineering standpoint only, if you will add the extra depth of excavation with the necessary extra width that would be required to maintain this depth, owing to the slope, to the price you have put on the Albemarle and Chesapeake Canal, I am satisfied you will find the Government will expend more money than though they accepted this offer of the Dismal Swamp Canal. If, coupled with this, you will take the words of commerce as represented to you here to-day, the comparison certainly is strong in favor of the Dismal Swamp Canal.

Col. ABBOTT. Is there anyone else to speak on that subject?

Mr. KING. That is all the canal company will have. Will it be your pleasure to have the representation which comes up heard at this time?

Col. ABBOTT. Yes.

Mr. W. I. HALSTEAD (South Mills, N. C.). Gentlemen, considering your valuable time, I will be very brief. I represent the delegation that you see in front of you—not excursionists, but people who are here to defend and fight for that which they have toiled and labored for these many years.

This delegation represents the interests of the 5,000 people who are property owners residing in South Mills Township, Camden County, and Newland Township, Pasquotank County, N. C., who are totally dependent upon the Lake Drummond Canal for transportation.

These statistics which I wish to make known here are all in North Carolina and in these townships I have just stated.

Now, the number of acres within the bounds of these two townships is practically 100,000, of which about 33,000 are in cultivation, and many acres are being improved each year. From the principal shipping point at South Mills, N. C., there is shipped annually the following: Eight thousand barrels of potatoes; 100,000 bushels of corn; 800 bales of cotton; 1,500 crates of green truck; poultry, eggs, cattle, and hogs to the amount of $100,000.

And to this point there is shipped annually 600 tons of fertilizer, 1,000 tons of lime, 5 carloads of wire fencing, and merchandise to the value of $150,000.

The timber industry, giving employment to a great number of people, cutting the timber from a forest of about 60,000 acres, including the operation of the sawmills, is entirely dependent upon the Lake Drummond Canal for transporting their products to the markets. The aggregate shipment of said timber annually is about 5,000,000 feet and entails a value of $60,000.

It is believed that the report incorporating the recommendation of the purchase of the Albemarle and Chesapeake Canal by the United States Government as a part of the proposed inland waterway by the Board of Engineers, making a survey of these proposed routes (the Albermarle and Chesapeake and Lake Drummond or Dismal Swamp Canal), was made and influenced by the only predominating feature of the Albemarle and Chesapeake Canal (that of nearer sea level than the Dismal Swamp Canal) that this work of the engineers was directed and done from an engineering standpoint, and that their labors were concentrated on the one engineering feature (the route nearest sea level), not considering the disastrous effect upon the interests of thousands dependent upon the Dismal Swamp Canal.

Therefore, as a basis for our appeal to you to recommend in your report to Congress the purchase of the Dismal Swamp Canal by the United States Government and to be maintained as a free waterway, we submit the following:

(1) That the Albemarle and Chesapeake Canal, bordering as it does upon the very skirts of the sand banks on the coast and for a great part of the distance within reach of a shot of the gun of the enemy upon the Atlantic and in the wake of storms that sweep along the coast, affects the interests of but a small territory.

(2) That the Lake Drummond Canal is from 25 to 40 miles from the sea and is through a great farming and timber region, affecting in acres several hundred thousand and in population many thousand people whose entire earthly belongings are along the route of this canal, and the value of which is entirely dependent upon this canal being maintained as a waterway as a means of transportation.

(3) That the purchase of the Albemarle and Chesapeake Canal alone would not only result indirectly as a confiscation of the property of the Lake Drummond Canal & Water Co., but would so depreciate the value of such vast amounts of property along its route that has derived its value through the improving and maintaining said canal as to be indirectly a confiscation of the property contiguous to this route and thus cause deterioration of this vast section of country and destruction of property rights which has cost years of toil and labor to the owners.

(4) That in the event that the Albemarle and Chesapeake Canal alone is purchased, it is evident from the report of the Board of Engineers that the owners of the Lake Drummond Canal should be indemnified, but as to the owners of property along the route of this canal, where is our right of appeal? From whence comes our indemnity?

(5) That if the aggregated damage caused by the purchase of the Albemarle and Chesapeake Canal alone (resulting in the abandonment of the Lake Drummond Canal) was considered with reference to this purchase, the sum would more than reimburse the National Government for purchasing and maintaining the Lake Drummond Canal as a free waterway.

Mr. HARVEY M. DICKSON (Norfolk). May I ask a question?

Col. ABBOTT. Certainly.

Mr. Dickson. What proportion of the tonnage passing through the Dismal Swamp Canal originates in the territory in which the canal is cut?

Mr. W. I. Halstead (South Mills). Well, sir, I could not tell the exact portion. I would state that there is a great amount of it.

Mr. M. K. King (Norfolk). About 50 per cent.

Col. Abbott. Is there anyone else to appear on that side?

Mr. King. Mr. Stewart, a Government employee in the Navy, has a very intelligent paper on this subject which I think would interest the board.

Mr. R. E. B. Stewart (Portsmouth, Va.). Mr. Chairman and gentlemen of the board, it is with reluctance that I appear before this board to discuss a question of such vital importance as the inland waterway project, and I recognize the fact that I am addressing experts in their profession who have technical knowledge which the average layman does not possess, yet I desire to present to this board some general observations, other than from an engineering standpoint, in connection with the proposed inland waterway between Norfolk Harbor and the Albemarle Sound, which, I think, should be carefully considered and investigated before any particular route is recommended. The question should be looked at from every phase. The matter of costs—that is, to cut so many cubic yards of earth between two given points—should not be considered, but only as to the best route for serving commerce, for the naval service in time of war, for drainage of swamp lands, for the utilization of water power, and for furnishing fresh water for the Government plants, to my mind, should be the main features in selecting a route, as the Army engineers have already pronounced each of the routes proposed practicable. In short, the route that will serve commerce and the Navy best, and at the same time pay back to the Government some revenue in return for the money invested, is the proper route to be selected over any other, and that one, in my opinion, is the Dismal Swamp Canal.

Let us look for a moment at the relative merits of the two proposed routes—the Albemarle and Chesapeake and the Dismal Swamp Canals.

Advantages of the Dismal Swamp Canal:

(1) A shorter route.

(2) It would drain most of the Dismal Swamp, provided the water in the canal was lowered, say, at least 2 feet, and open up to cultivation an immense area of fertile lands now lying idle, a great public improvement for Virginia and North Carolina. The scheme of drainage is practicable, as will be seen by the Tenth Annual Report of the United States Geological Survey and from practical demonstration by farmers along the line of the canal who have won to agriculture already a considerable portion of this morass of drainage.

(3) A supply of fresh water could be furnished to the Norfolk Navy Yard, naval magazine, marine barracks, training station, and naval hospital; water is also furnished from the yard to ships there, and also carried to Hampton Roads and Newport News in water barges and tugs to ships stopping at these points at times. This would be a great saving to the Government, for last year from June 30, 1909, to July 1, 1910, $27,714.10 was paid to a private corporation for water, and the amount consumed is increasing every year. This does not include the cost of water used at marine barracks and naval hospital.

(4) This route runs by Elizabeth City, one of the most important commercial towns in North Carolina; also is nearer the important commercial cities and towns of eastern North Carolina, contiguous to the Albemarle Sound and its connecting rivers.

(5) Possibly it would be feasible to establish a fresh-water basin at the northern terminus of the canal (Deep Creek), for the use of laying up torpedo boats to free their bottoms of marine growths, or preferably to furnish water for a lay-up basin and timber basin established at the Norfolk Navy Yard.

(6) Navigation would not be impeded on account of the winds and tides, which occasionally causes a depression of water in the Albemarle & Chesapeake Canal, and greatly interferes with navigation.

(7) Nearer inland; therefore, is far removed from the range of the guns of an enemy.

Disadavantages of the Dismal Swamp Canal:

(1) Lock canal.

(2) It runs along the eastern edge of the Swamp on virtually a hillside, and if a deeper channel was required without locks, it would have to be dredged to a greater depth from the surface of the earth than the other canal to make it a sea-level canal, and therefore would be impracticable.

Advantages of the Albemarle & Chesapeake Canal:

(1) Practically a sea-level canal.

(2) Cheapest route to enlarge to the required depth as compared with making the Dismal Swamp a sea-level canal.

Disadvantages of the Albemarle & Chesapeake Canal route:

(1) Longer route.

(2) Salt water. It would be no profit to the Government as a source of water supply.

(3) Its improvement would be of no benefit for the drainage of the adjacent lands for agricultural purposes.

(4) It passes through a vast marsh section and lowlands where commerce is deficient and is far removed from any town or city of any consequence.

(5) During certain seasons of high northwesterly and northeasterly winds the water is occasionally blown out, thereby interfering with navigation.

(6) Possibly the most expensive route to maintain in the way of keeping the channel open on account of the shifting sands in the bottom of the sounds, rivers, etc., through which it passes.

From this comparison which I make it will be seen that the only advantage of the Albemarle & Chesapeake Canal over the Dismal Swamp is that it is practically a sea-level canal. But, as a matter of fact, is not a lock canal preferable, as there is some difference in the tide level at each end, and in a lock canal there would be no effect from winds and tides, and when a vessel enters the locks it is known exactly how much water can be carried. The Panama Canal is a lock canal and the Chesapeake & Delaware also; then why object to Dismal Swamp on this account? By retaining the locks, the Dismal Swamp Canal can be deepened to a 12 or 16 foot channel through the other route and meet the demands of commerce better; besides, it has other features which tend to make it more desirable for the use of the Government from a financial standpoint.

But, Mr. Chairman, I favor buying both canals. I do not believe it is just and right to buy one and leave the other out at a great financial loss to the owners, for they are competing lines, and both are dependent for their life upon the same territory for traffic. This would be a policy of confiscating private property. Surely Congress will never pass such radical legislation. It would be contrary to the fundamental laws of the land which guarantee to every citizen the protection of life and property. The Government has the best horn of dilemma in this matter. There have been three routes located; you can say to these private corporations "sell at a reasonable price, or we will build the Cooper Creek route," and they will sell, no doubt, at a reasonable sum under such circumstances, and no exorbitant price can be charged.

Let both canals be purchased. The increased commerce incident to the opening of a deeper channel between Beaufort Inlet and the Chesapeake Bay should not be bottled up by one narrow canal cut which intersects the strip of land lying between Norfolk Harbor and the sounds of North Carolina. A cave-in or some unusual occurrence might block the canal channel, which is dependent upon congressional appropriations for maintenance, and which at times must wait for years to obtain and do untold injury to the commercial interests, when with two canals, furnishing double track navigation, as it were, no apprehension would be felt in this regard.

Possibly a practicable and beneficial way for the Government to make use of both the Albemarle and Chesapeake and Dismal Swamp Canals, if taken over, would be to sheet pile and dredge both to a necessary depth, and make one a passageway for rafts, barges, and other tows, and the other for deeper draft vessels propelled exclusively by their own steam, with the exception of local tows and traffic; then there would be no likelihood that a congestion in traffic would occur, and it would not be necessary to widen either of the important waterways, except in a few turnouts. Or, another plan, one canal could be used for traffic going south and the other for that going north, if both had the same depth of water.

But, Mr. Chairman, this is simply a suggestion. The main point is, that if these canals are taken over by the Government, they should be maintained, and at least reasonable transportation facilities furnished for the accommodation of the property owners and tax payers who live along these routes. The canal owners can sell out and one or the other canal put out of commission, but the people who have enjoyed these rights of transportation for their produce will have to suffer; and I am here in a small part to represent the property owners along the route of the Dismal Swamp Canal, and to ask that you give the rights of the property owners especial attention in this matter. We have had the use of this canal for nearly a hundred years, and it has become a vested right to have the facilities for transportation afforded thereby. To abandon this route means a step backward for a hundred years possibly. Surely this will not be the policy in this progressive age of invention and progress.

There is a sentiment, too, connected with this Dismal Swamp route. It was originated by that great warrior and statesman George Washington, the Father of his Country. He was one of the first stockholders, and it was his master mind that found out the wonders of the Swamp and as to the watersheds lying about Lake Drummond. He builded possibly better than he knew, for in spite of everything this large area of fertile swamp lands will some day in the near future be developed into the greatest garden spot in America. A private corporation, the Dismal Swamp Canal Co., when it took hold of the canal and enlarged it to meet the demands of trade, helped

no little in hastening the progress of this much neglected section. Do not go backward in the march of progress. Take hold of this canal and maintain it, for its services are needed not only to develop this wonderland, but to assist in bearing the "white wings of commerce" over peaceful waters through the inside route to pour their valuable cargoes in the lap of trade, escaping the tortuous Hatteras where death and destruction constantly await a victim.

I have the honor to suggest that the Secretary of the Navy be requested to appoint a board of naval officers from the Norfolk Navy Yard to cooperate with Col. Patrick to determine the possible utility of the Dismal Swamp route as a water supply, etc., as outlined in my remarks. [Applause.]

Mr. M. K. King (Norfolk). This last delegation which came in is one from Elizabeth City. Are you prepared to hear them?

Col. Abbott. We will be glad to hear them. I would like to say that this morning, hearing your delegation would be late, I postponed the meeting an hour. At 11 o'clock I thought it not proper to keep the rest waiting, so we began the hearing.

Mr. E. F. Lamb (Elizabeth City). We appreciate the courtesy. We are not surprised you took the course you did.

I want to present and represent a party of citizens of my town for whom I speak this morning, and whose interests are at stake.

While this is the first time I have had the honor of addressing a court made up of Army officers, I have long since learned by association to respect them for their official integrity, and to love them for their social qualities.

In presenting my views on the subject under consideration, probably at times with too great zeal, let it not be inferred that I am lacking in respect for this court, or for the action of those engineers who have hitherto passed upon the relative present efficiency or future usefulness of Albemarle and Chesapeake and the Dismal Swamp Canals.

As I understand it, it is your province to give a full hearing to all parties interested in the purchase by the Government of a route for the proposed Norfolk-Beaufort inland waterway; your report is to be the basis of an act of Congress providing for the purchase of the waterway route, and no contract can be made by the Secretary of War unless recommended by you.

The jurisdiction of this court is therefore broad. You not only deal with the technical engineering features of the project, but you are authorized to consider and weigh the equities, and to determine the justice with which the project is to be completed.

I shall attempt to present to you the consequences of the proposed change, in behalf of those wards of the nation whose welfare is dependent upon the maintenance of the Dismal Swamp Canal.

If I can emphasize sufficiently your obligation as representatives of our National Government, to exercise a paternal care and protection over the property of the people, a purpose for which the Government was founded and for which it continues to exist, I shall present my cause with more courage and possibly more grace.

Let me assure you, sirs, it is a question of the greatest importance to those for whom I plead.

To close the Dismal Swamp Canal means the destruction of the property of those living adjacent to the canal. It means in many instances the loss and abandonment of now thrifty homes. It means the displacement of Elizabeth City from the line of progress and development. It would spell ruin to a now rich and growing section of North Carolina, made accessible by the Dismal Swamp Canal, whose property values, with the closing of its only waterway, would shrink and decline to nothing.

Such a policy would be in direct conflict with the present plans of the Federal Government in the reclamation of arid lands in the West; contrary to the policy enforced in the drainage of swamps in the South; contrary to the good-roads movement throughout the country, and in violation of the general policy of extending deeper waterways.

It would be a policy of destruction, and not a policy of conservation. It would destroy the interests of a people, and not build them up.

It may be said that we have the Norfolk-Southern Railway at Elizabeth City. Surely because we have the railroad is no reason for taking from us this waterway.

It may be said that we will have a free canal by the Albemarle and Chesapeake route to offset the old toll canal by the Dismal Swamp.

The people of my section would bear their share of the expense of establishing and maintaining a deeper waterway.

Better by far to pay toll and keep open the existing route than to be taxed and deprived of our only waterway, to support a route that would destroy property values, and ruin our growing city.

If the free inland waterway should go by the Albermarle and Chesapeake Canal it will mean 40 miles farther haul to Elizabeth City traffic. The longer haul means

higher charges and loss of time, and the selection of the Albermarle and Chesapeake Canal means to Elizabeth City a loss of all commerce along the line of the new inland waterway, and the removal of existing trade; a drop from the skyline of commercial activity to the abyss of dead and forgotten settlements.

So you will understand, sirs, that we are here to fight for our lives. The fight, thank God, is not among our enemies, but among our friends.

Our enemies they are who charge that we are delaying this great project that has been the dream of legislators for years. That charge is a stab from the hands of a Brutus who has fed at our breast.

This is a section that has grown rich from the ship cargoes that have emptied into Norfolk the golden grain, the cotton and timber, the products of North Carolina, a land it has pleased God to smile upon.

Norfolk has prospered and grown by the brain and brawn of North Carolinans who came here at the close of the Civil War and gave this city the impetus largely responsible to-day for the success the city has attained.

The relations, commercially and socially, between Norfolk and northeastern North Carolina have ever been of the closest, and it is no stretch of the imagination to assert that the Dismal Swamp Canal has been a link between the people of the two States; for many years it was the only means of communication, save by the worst highways conceivable.

We have had the Dismal Swamp since the earliest days of this American Government. Washington Irving relates a trip on horseback made by the Father of His Country, when his horse sank into the mire of the Dismal Swamp.

It is a historical fact that George Washington was connected as an engineer with a survey and laying out of the canal.

The Virginia Legislature passed an act in 1787 authorizing the construction of what afterwards became the Dismal Swamp Canal, though they were 30 years completing it. This canal remained the only water route from the sounds of North Carolina to Norfolk for a period of 50 years, during which it was the bottle of milk upon which the municipal infant at the North Carolina end fed with ravenous appetite (The construction of the Albemarle and Chesapeake Canal began in 1856.)

It is a matter of record from the engineer's office of the United States Army, Norfolk, Va., August 31, 1903, that the General Government ordered a survey in 1837, from the southern end of Dismal Swamp Canal southward to Winyah Bay, S. C.

In 1875 another survey covering generally the same territory as at present under consideration.

And another in 1878 of all water lines and routes leading from the harbor of Norfolk, Va., to the Atlantic Ocean south of Hatteras.

In 1894 Congress directed the survey of the waterways through the sounds of North Carolina and of the Dismal Swamp Canal, Virginia and North Carolina, and of the rivers and water connections connecting said canal with the sounds of North Carolina.

In 1900 another examination and survey was ordered, this time from the southern end of the Dismal Swamp Canal to Beaufort Inlet, through a route specified in the act to pass via Croatan, Pamlico, and Core Sounds.

The Dismal Swamp Canal, so says the record, throughout its whole extent passes through what was originally the Dismal Swamp, but from which large tracts have been reclaimed by drainage.

The point I make, if the court pleases, is that since the earliest days of the development of this section of country, the Dismal Swamp Canal was the keystone to the arch upon which we built. Since the ditch that first floated the logs that were used by the Government to construct a navy, we have drained the lands, shipped the timber, builded cities and villages and established homes that vie in comfort and elegance with the best settlements of North Carolina and Virginia.

All of which was made possible by the use of the Dismal Swamp Canal. The Dismal Swamp Canal is ours by right. We have opened up lands that are unsurpassed in productiveness by any other lands upon the globe.

For agriculture the valley of the Nile can not excel it. There are thousands of acres of such lands, cultivated and producing wealth to the country, equal to the famous gold mines of the West. There are hundreds of thousands of acres waiting for the spade and plow.

We have mortgaged those lands in many instances, and have built upon them substantial homes, and are looking ahead to greater advancements in wealth and civilization through the efforts of our children.

Along the banks of the Dismal Swamp Canal the villages of Deep Creek and South Mills have been planted. They are remote from all other means of transportation.

On the river south of the canal is situated Elizabeth City, with its 12,000 population, most vitally interested in this subject at issue.

A city up to date in all the modern features of a growing community. Handsome public buildings, educational institutions of the highest order, beautiful residences, telegraph and telephone systems, first-class banking facilities, an extra good harbor, extensive marine railways, manufacturing plants, and a commercial business, wholesale and retail, a city twice its size might envy. Our forest products handled in Elizabeth City during the past year foots up 242,990 tons. The farm products, 55,079 tons. The water products, 28,262 tons, giving credit to us for the contribution to the three great essentials of life—food, shelter, and raiment—the sum total of 326,336 tons. May it please the court, I can not omit to add, we have 400 tons of holly and mistletoe to our credit, and that we are contributing our share of the joys and pleasures of our fellow man and to the happiness of the children of this great country, to whose welfare you have devoted your lives.

Do not understand me to rest our commercial strength upon those items alone. Our coal freights add up 11,000 tons, wire fencing and nails 2,100 tons, our textile mills 3,000 tons.

I will not tax you with a full list, but there are hundreds of articles of freight that can be added hereto. I have not included drugs and spirits, scrap iron and metals, cotton seed, honey and beeswax, hides and tallow, horses and mules, farming implements, stoves, hooded shelves, empty barrels and crates, oil, over 600 barrels a month, fertilizers, wreckage from Hatteras, pianos and organs, automobiles and bicycles, carriages, wagons, and harness, rags and bones, electric motors, steel cables, steam and plumbing supplies, boilers and engines, rafting gear, steam hoisters and iron skidders, etc.

The growth of our city has been steady and devoid of a shadow of a boom. All lines of development have kept pace with the normal growth. The First National Bank was organized in 1891, at that time the deposits were $50,000. Later the Citizens Bank came into existence, which was followed by the Savings Bank and Trust Co., then the Mercantile Bank; the combined deposits of these banks foot up $1,000,000.

The post-office receipts have steadily increased $1,000 per year for the past 10 years. The taxable value of the county 20 years ago was less than $1,500,000; in 1909 it was $4,184,316.

Since the reopening of the Dismal Swamp Canal the growth of our trade and development has increased 25 per cent.

With the opening of the standardized canal and the retention of the Dismal Swamp Canal our city will increase its commerce tenfold in the next 10 years.

In arguing the merits of my cause it becomes necessary to touch upon the findings of the engineers in the reports heretofore made:

"Before entering into a comparison of the different possible routes for the waterway there is an important question to be decided: Shall the waterway be constructed as a sea level?

"After a consideration of all these and other points, the board is of the opinion that the waterways as constructed should be at sea level, and in comparing the different possible routes, they all have been considered with reference to their feasibility for the construction of a sea-level canal."

Quoting from this same report, we have this under the following heading:

"COOPER CREEK ROUTE.

"This route proceeds by the shortest line from Elizabeth River to Albemarle Sound, and avoids the most tortuous portions of both the Elizabeth and Pasquotank Rivers."

Further along, the report centers down to the Albemarle & Chesapeake Canal and Cooper Creek:

"Assuming for the purpose of comparison that all the rights and property of the canal company would be ceded to the United States free, a route by the canal seems to have the advantage of a slightly smaller first cost, the difference being $42,000 in a total of about $5,000,000.

"If, however, the cost of maintenance be considered, the advantage is on the other side. The Cooper Creek route passes practically for its whole extent through the interior, where the cost of maintenance will be light, while the canal route passes for a long distance through the open part of Currituck Sound. As regards navigation, the canal route is several miles longer, and vessels passing by it will, while in Currituck Sound, be exposed to the winds and storms from the open ocean.

"It has also another great disadvantage in that the water level in Currituck Sound is subject to greater fluctuation, and especially depression, than any other portion of these water routes.

"Taking into consideration, therefore, not only the first cost but also probable cost of maintenance, the ease of navigation, the length of the two routes, the question of the relative protection from storm, and the fluctuation in the water level, the board is of the opinion that the Cooper Creek route is the better, and in the long run prove the cheaper, even on the assumption that the rights and property of the canal company could be acquired free."

Still quoting from the report:

"The law is mandatory, however, only as to any private waterway that it may be to the interest of the United States to acquire. In the opinion of the board it is not to the interest of the United States to acquire any of the existing waterways, for the reason that the Cooper Creek route appears to be the best and really the least expensive line for the waterway, and by adopting it all complications as to the purchase of either the whole or part of either of the existing canals are avoided.

"The board has, therefore, no hesitation in recommending for this division of the waterway the Cooper Creek route."

In summing up the entire route selected by the board of engineers the report has this to say:

"This route has the advantage of the greatest possible amount of protection from storms throughout its lengths, of having safe harbors at each end of every land cut, of passing close to Elizabeth City, etc."

In the conclusion covering the entire route from Norfolk, Va., to Beaufort Inlet, N. C., the engineers say that—

"After carefully considering all available data as to its present and prospective commerce, the board is of the opinion that the route herein recommended for inland navigation between Norfolk, Va., and Beaufort Inlet, N. C., is feasible, and that the estimated cost of same is not out of proportion to the extent of said commerce added to the importance of the completed waterway as a factor in coast defense.

"Chas. J. Allen,
"*Lieutenant Colonel, Corps of Engineers.*
"James B. Quinn,
"*Lieutenant Colonel, Corps of Engineers.*
"E. Eveleth Winslow,
"*Captain, Corps of Engineers.*

"Brig. Gen. G. L. Gillespie,
"*Chief of Engineers, United States Army.*"

It is not for the purpose of inducing you to declare in favor of the Cooper Creek route I have gone so much into details on so familiar a subject, nor am I ignorant of my apparent inconsistency in making prominent the advantages of that route; but in all fairness and with candor I can not but be impressed with the possible action of this board in a question that so vitally affects the successful issue of this great canal system.

It would be a great presumption on my part to say that in the event the Cooper Creek route was adopted and constructed by the Government what action Congress should take in reimbursing those who would suffer by the loss of one or both the other canals.

There is one feature relative to the opening of the Cooper Creek route that was not touched upon by the engineers. That was the drainage of an immense section of the most fertile land of eastern Carolina.

It is fair to infer that Congress was influenced by other reasons than that of expediency when they passed the acts of 1909 directing this investigation to the two canals, with this report of the engineers before them.

If it was in consideration of existing interests they passed this act, then my point is made good, that this court would be justified in giving full consideration of the interests of those I represent.

Pardon me if I go into the comparative merits of the two canals in a general way to further sustain my position.

We are not here for the purpose of hindering and delaying the construction of the inland waterway, and we emphasize our position, that we are in favor of such action as shall be taken by this board, provided we have secured to us the use of the Dismal Swamp Canal for such purposes as it is now used for.

Adding to the force of the statement made by the board relative to the difficulty from storms and water depressions, I volunteer the information, the sailor man will corroborate, that during several months of the year the traffic through the Albemarle & Chesapeake Canal is often congested by storms and tides.

Reverting, then, briefly to the relative values of lands affected:

Along the Dismal Swamp Canal there are prosperous farms and thriving villages depending upon their success on the transportation afforded by the canal.

Much now unimproved land is susceptible to drainage and subsequent cultivation.

Along the Chesapeake there is little agricultural land, and little susceptible to improvement.

In conclusion, sirs, I would remind you that upon your decision depends the future of our people of northeastern North Carolina.

If the Dismal Swamp Canal is closed, we have indeed no future, or at best a black one, a prospect I fear to contemplate, a promise of abandoned homes and deserted communities.

If you leave to them their existing waterway, yours will be the hand that will wave the magic wand to conjure up thrift and content, well-to-do farmers in a rich country, growing villages, and thrifty cities in a section whose commercial development will keep pace with the great benefits of the greater inland waterway.

We are pleading, not for an idle cause, not for a matter of greater convenience; we are pleading with you for our lives. Is our prayer to be answered with a blessing or with a curse? Sirs, I thank you.

Mr. J. B. Leigh (Elizabeth City). Mr. Chairman and gentlemen, I doubt not you are getting wearied with so much talking, because on a common question of this kind there is a great deal of repetition.

After what has been said to you, you can see we are very much interested in this inland-waterway project down our way. We deem that it means a great deal to us, and, as we see it, to adopt another route than one of the two that goes to the Pasquotank River will do us and our section a great injury. While, on the other hand, to understand the value of the two waterways, it can not hurt any other territory, because the reports of the engineers, as I understand, show that about 4 miles from North River the distance to Norfolk through either of these routes is about the same, being about a mile shorter through the Dismal Swamp Canal than through the Albemarle & Chesapeake Canal. The people who live directly on and who are interested in the Dismal Swamp Canal can not be hurt by the adoption of either of the routes that comes out of Pasquotank River, because you can take it up and down and they meet at a common point. All the proposed routes converge in the Elizabeth River; therefore, the Norfolk end, no matter which you may select, makes it equally convenient to Norfolk and everything north of this end of the canal; so, therefore, as I see it, we who live on these canals are the people who must go to the Government, as the Government must put up the costs.

As I understand, the object of the Government in these internal improvements is to do the greatest good to the greatest number. We are willing to go down or rise upon that proposition. As we understand it, our purpose is not to confiscate the property of either canal. I do not believe the Government will do that. Of course, as coming from us, we can not be so patriotic as to give up our commerce for the upbuilding of some other locality.

Our community has grown up from the very day of the beginning of the Lake Drummond Canal. Our town began the very year, according to Wheeler, that this canal was first opened (in 1874 I think it was—that is, the first grant or concession of land). From that time we have grown up and have been growing up to the present time.

To cut us off puts us at greater distance from Norfolk, or the Elizabeth River, while all the other people who may be interested, or who may go through this canal, have the same advantage if you adopt the Dismal Swamp route, because they are as close to Chesapeake Bay, or Norfolk, or the Atlantic Ocean, as they would be if you took the other route. According to the Engineers' report they are 1 mile nearer. Should it be the policy of the Government that they should depreciate the value of our property, stop the progress of our town, for the purpose of putting a canal through and putting it 30 or 40 miles farther from the town, and thus shut out competition between the present canal and the railroad line? We do not believe that.

The Government went there some years ago, and they regarded us as the commercial center of eastern North Carolina; they appropriated $140,000 to give us a post office and grounds. They had great faith in us. We have shown them that their faith in us was not ill shown. It has been said our post-office receipts have increased $1,000 or more a year, and our commercial increase has been as great. I think in and around Elizabeth City we have spent $500,000 or more in building manufacturing plants and other improvements, and all these buildings and plants are to a great extent predicated upon this inland waterway, because one of the greatest manufacturing plants we have is the Dare Lumber Co.; up to September 1 they have shipped 27,000,000 feet of timber, of which only 9,000,000 feet had gone by rail; the other had gone by

this canal. To say that it will not discommode this and other lumber companies to go 40 or 50 miles out of the way, will be a hardship on them.

As I understand, it is the purpose to build an inland waterway, and not build a waterway subject to the Atlantic storms, which are constantly bottling up and choking up the canal.

All these engineers come and in their reports tell us that the Dismal Swamp Canal is a way secure and protected from storms.

To you gentlemen it would be foolish to talk from a military standpoint what the effect would be. In case of war with a foreign country, that place would be under the direct charge of their guns from the Atlantic Ocean. In building this canal we are not building it for a day, or 10 years, or 100 years, but as a Government improvement. They should not contemplate conditions as they exist to-day, but in the future, and not only build a canal of inland waterway that will protect us in time of peace, but we should build with a view to what may happen in the future. If two routes are marked out, as I see it, the route should be chosen which will insure a protection at all times. According to the report of the engineers, if you take the route of the Albemarle & Chesapeake Canal, at the mouth of the North River, they tell me that there is a bar out there that it is almost impossible to secure a permanent waterway there. On the Pasquotank River, while there is a shoal there, we have a channel 12 feet deep. Up this way we have the whole Currituck Sound, which is affected by the coast winds. Up this other way (the Dismal Swamp), it is inland and not affected by the tide or by the winds at all, because it is internal.

It has been said it will have a tendency to bring to cultivation a great tract of land, as rich as anybody can imagine, as rich as now on the Beaufort Sound, just as rich as the Hyde County land. The soil in the Dismal Swamp land is from 7 to 10 feet deep. If the Government builds up wealth along the route of this canal as we are doing, it adds to the wealth of the nation; therefore, we are strengthening the arm of the nation. But for the Government to come and build another canal, so it can not possibly be developed beyond a slight degree, and shut out this territory that has been developing and growing and increasing in population the past 100 years, it is doing great injury to us. We do not want to do anything to the disadvantage of any people in North Carolina or any other part of the world, but we do ask for fair play. We say if either of these routes affects anybody alike, except the people in our immediate section, we say our progress should not be stopped, that our wealth ought not to be curtailed.

We have a population of 30,000 or 40,000 people who are directly interested in this route. The adoption of this route and opening of this canal means a great deal to 30,000 or 40,000 people. The tax rate in our community is $3,000,000, and that means a value of $8,000,000 or $10,000,000, because you know the tax rate is never more than one-third of the real value, and it means the jeopardizing of these vast interests. I do not mean to say you are going to confiscate that propery, but it puts us out of the way. It does virtually confiscate that property, because they are virtually cut off from outside communication. It means the cutting down of value at least from one-half to two-thirds of this section. It means cutting off our town from competition with Norfolk and Chesapeake Bay. We necessarily feel interested in it.

We do hope we can impress upon you gentlemen our earnestness and our zeal. The Government has helped our town. They have seen that there was something in our location. They have seen that there is something in the progress we are making. They have seen that they were justified in spending $140,000 there, and now here is a proposition to cut down the faith the Government had in us. It means that we must curtail our manufacturing and commercial establishments. It means that we are put at the mercy of only one line of transportation; that we must go out of our way 30 or 40 miles. When we go through the Dismal Swamp Canal it will not put a person in North Carolina a single mile out of their way, and for the Government to say that for a few thousand dollars they will make all these people suffer, I think places a hardship that the Government will not perpetrate upon the people.

According to the report of the engineers the extra cost of this other canal will compel the people of this section to lose that much money, and more, too, because you take $8,000,000 or $10,000,000 in our county and $4,000,000 or $5,000,000 in Camden County in keeping away manufacturing plants—because we do not know that manufacturing plants are looking for cheapest freights—if we cut off one of our lines of communication it is an invitation to the manufacturing plants looking for location to go elsewhere. We do not know to what extent in dollars and cents the change of this route of canal will hurt Elizabeth City and this community, because we are dependent on this route. If you adopt the Dismal Swamp route, and give us any fair chance, it will save several hundred thousand dollars put down there that will cost to dredge out

Pasquotank River; you can't go up the Pasquotank River unless some dredging is done. If you take it up in South Mills and that section, it will have to be dredged to give a fair chance. Certainly the Government will not work such a hardship on that section as to give those people an outlet and say to these people who live up there we will not. The time will come, and it is right here now, that the Government will have to go and dredge this out at an additional cost. It is as near for the people of Currituck County to come our way as to go through the Albemarle & Chesapeake Canal. In fact, two-thirds of their commerce comes to Elizabeth City. There is only a small part that goes out through Currituck Sound. It will not incommode these people any until you get up to North Landing River.

Take the whole thing as we have presented it, which route will do the least damage to the most people? We have endeavored to show to your honorable board that neither community at either end of the canal will be affected as to the distance or the haul that they will receive, except a mile or two. Take the routes of the two canals, the territory that they pierce. Which canal will do the greatest damage—I mean the shutting up of which canal will do the greatest damage? We have in one section of the Dismal Swamp Canal 3 miles through this peninsula Coinjock; two-thirds of those people go to Elizabeth City through the canal or by rail. The only village is Coinjock. I believe there is one manufacturing plant there, and there is the little village of Mundens Point, which was started incident to the coming of the Norfolk & Southern Railroad. We have at Elizabeth City cotton mills and other plants, the aggregate capital of which is over $1,000,000. It is going to put them about 30 miles farther from Norfolk. We go up 22 miles, and every foot of this land can be put to the finest state of cultivation. It is the richest soil we can get, because it is the accumulation of vegetable matter which has been there accumulating and decaying. It will produce anything that we want to put in the soil. That whole territory will be virtually confiscated until some thrifty person comes through with a railroad.

We come to South Mills and Wallaceton; they have manufacturing plants there, and there are most valuable farming lands up and down this canal. All these will be greatly depreciated in value if this canal is closed up. Elizabeth City is bound to be put back years and years in its growth. The post-office receipts must be cut off, and the faith of the Government in Elizabeth City must be depreciated because her facilities for dealing with the outside world will not be what they were when the Government came to see us and established our $140,000 post office.

The only thing we want is fair play. We do not want to hurt any other interest of North Carolina, but do not put us 30 or 40 miles from Chesapeake Bay when you can put us the same distance as the rest of North Carolina by using this old canal. We ask you to deal with us as you wish to be dealt by in this matter.

Somebody may say if you shut up this thing it will bring more trade to Norfolk. That may be so, but we are willing to compete with any town, when it comes to hustling, if we have the same natural advantages. We do not ask you to give us the advantages of some place superior in wealth. We ask you, gentlemen, whether this must be a lock canal or sea-level canal, to look over the whole territory to see if we are not warranted in the request we make that you give us the Dismal Swamp Canal, or some canal that will tap the Pasquotank River, and not put back in its progress a town that has been growing and increasing and doubling in population almost every 10 years. Our population in 1890 was a little over 3,000; in 1900 it was between 6,000 and 7,000; and this census gives a little over 12,000.

We feel our progress will stop with the closing of this canal; that we will be greatly handicapped if you cut off this way of transportation to us to the disadvantage of 30 or 40 miles.

God has given us a grand, good location, and we think the Government will not thwart the purposes of our Creator, but it will continue its munificent effort to help us and to increase the wealth of our people.

Mr. George W. P. Overman (Norfolk, Va.). The honorable Board of Army Engineers: Gentlemen, I am here representing the American Association of Masters, Mates, and Pilots that now operates the vessels navigating in these canals. Our membership is approximately 300 in this locality, and we have been considering this matter before you from a citizen standpoint and a practical standpoint. We thank you for this opportunity to present our views on this subject, and we have the following:

Whereas, there is to be a public hearing before a board of United States Army engineers, who will sit at Norfolk, Va., September 6, to listen to arguments from all those concerned in the selection of one of the (two) canals that connect the inland waters of Virginia and North Carolina, viz, Albemarle & Chesapeake and Dismal Swamp Canals; therefore, be it

Resolved, That the Progressive Harbor No. 9, American Association of Masters, Mates, and Pilots, of Norfolk, Va., do hereby unanimously indorse the Dismal Swamp

Canal as the proper route to be purchased, improved, and maintained as an open and free watercourse between Norfolk, Va., and the sounds of North Carolina, for the following reasons, viz:

(1) That by the large number of shipping concerns that are using it in preference to the Albemarle & Chesapeake Canal, thereby establishing the fact of choice of the two routes.

(2) It lies through the most fertile section of Virginia and North Carolina, and its inestimable wealth, when drained by the deepening and widening of this canal, is now unknown to the many people that will be attracted to this section when such improvements are made; the thousands of acres of the most fertile land, now covered with an abundance of timber, and when this has been removed the yield of farm products will be sufficient to startle the imagination of the most skeptical mind, and increase the mercantile, shipping, and manufacturing industry beyond conception.

(3) At present it affords the most convenience to the shipping interests, such as points of supplies, repairs, and communications, and this present advantage will contribute materially in the improvements of this canal.

(4) From a military or strategic standpoint it will afford the most protected route during any time of national or foreign hostilities, such as being out of reach of the guns of the enemy that may get advantage of the coast.

(5) That the number of towns and villages lying on the banks of this route should be taken into consideration of what their commercial value would become with such improvements and what would be their destiny if this route should be rejected.

(6) That at Elizabeth City, N. C., is afforded an excellent harbor for all vessels while waiting for a tow, and the great convenience of a quick and direct railroad between there and Norfolk, all methods of communication; repairs can be made or supplies furnished while waiting there for favorable weather or to be towed through to Norfolk.

(7) While we realize that it will require a vast amount of work and a great expenditure of money to make the required improvements, we do not lose sight of the fact that the revenue derived therefrom will amply compensate the efforts made and reimburse the Government for the outlay of the required amount of money for such improvements. Therefore, we, the practical men that will have to handle the life and property that will be constantly afloat on this route, believe that we are capable of some judgment in the matter, and it is with all seriousness that we ask you to consider the interest of the public and not the wish of a few in this all important matter of selection.

Resolved, further, That a suitable committee shall be appointed to present these resolutions before the Board of United States Army Engineers at the hearing on Tuesday, September 6.

Mr. M. K. King (Norfolk). Mr. Lindsey is the owner of the farm of 3,200 acres under cultivation on the Dismal Swamp Canal.

Mr. Frank Lindsey (Portsmouth). I want to say that I represent the community of Deep Creek, with a population of about 100 thriving and thrifty farmers, people representing 10,000 acres of cultivated land. We ask your careful consideration before condemning the Dismal Swamp Canal. Through this canal we get our crops to market and our necessary supplies, fertilizer, etc., for the farms. We ask that you will not condemn it.

Col. Abbot. I would like to ask you one question. Supposing the canal was put there at sea level instead of at its present level, would that do any damage to the agricultural interests lying there contiguous, damage to wells, by drawing off too much water?

Mr. Lindsey. I will quote from experts of the Agricultural Department who say that if that canal were made a sea-level canal the land brought under cultivation will solve the question of the high cost of living. It will bring under cultivation a great quantity of land and reduce the cost of living one-half; it will bring into cultivation the greatest garden spot of the world—not of America, but of the world. I can state that at my own expense I have built a dredge to drain my land to act in conjunction with the Dismal Swamp Canal Co., and this year's increase will pay for it. That is based on the present level of the land, by lowering the water in my ditches. I have had several of the Government engineers there, and they stated if the canal was lowered 2 feet it would bring into cultivation the greatest garden spot.

Col. Abbot. We would like to know whether it would ruin everything in the immediate vicinity?

Mr. Lindsey. No. You will have sand drainage, and you will be able to put gang plows and steam plows in and plow as they do in the West.

Col. Sanford. What is the nature of this land?

Mr. Lindsey. The very richest. It has a subsoil of clay and loam, and oyster shells, and decayed vegetation. I understand you gentlemen propose a trip through

there; I would like to have you look into that feature when you take the trip through the canal. I would like very much to have you as guests on the farm and show you the drainage features.

Col. Abbot. Is there anyone else to be heard from on that side? [No response.] Now, I would be glad to hear from some one representing another interest. I understand from Mr. King that the interests of the Dismal Swamp Canal have been presented. Who represents the other side?

Mr. D. S. Burwell (general manager of the Albemarle & Chesapeake Canal). After this forensic oratory, I do not think we have anything to say. We can't match the oratory.

I want to congratulate my friends from Elizabeth City on the showing that they have made. The only thing I rise to say is that the Albemarle & Chesapeake Canal deserves a good many of the harsh things said about it, but I do not think we deserve them all.

I have been with the canal 17 years and watched the tides, and the fluctuations in the water level of the canal since my 17 years' connection with the canal company, made by the wind, has not been over 2 feet. That has been the worst storm that we ever had, and it took four or five days to get it out. We feel that very much when it is down 6 inches, because vessels going through are loaded down to the very gunwales. Vessels are loaded to a 9-foot depth, and a difference of 6 inches in the water hurts very much; it would almost stop traffic, but this has never occurred.

One of the speakers referred to North River Bar. It is singular that he is not better posted, because they are well-posted men. North River Bar was a menace, but some years ago the Government put range lights there. They have not had any trouble there for five or six years. That trouble has gone by. I just want to correct that impression, that there is no trouble there. The whole trouble with the route is winds and tides. That is all we have to say about the physical conditions of the canal.

The Albemarle & Chesapeake Co., which I have the honor to represent, simply places themselves behind the Engineers' report, whatever that report may be. They represent the people of North Carolina and Virginia and the people down the coast as far as Florida will have a free waterway. The Deeper Waterway Association speaks for the people; they have trusted to the engineers to build that waterway, and that is what they will have—what the engineers say.

As to buying both canals, I am an old enough man to remember when 40 acres and a mule was the battle cry when we looked upon the freedman. The question is whether we have got to the darkey or the darkey has gotten to us. I am heartily in favor of the Government buying both canals, and it would be a good solution of the matter. We would be glad to get rid of our property, and would like for our friends to get rid of theirs.

There is, however, the question of getting the through waterway.

I want you to understand that the Albemarle & Chesapeake has her faults, but there is no use in exaggerating them. We have only 11 miles of artificial waterway, and we have rivers that can be easily canalized, and the engineers can make it a safer route; the Albemarle & Chesapeake is the best route for you to consider, if you consider the wants of the whole country. I thank you, gentlemen.

Mr. Tait (of Currituck County). I am very well acquainted with the tidal conditions of eastern North Carolina. I am a native of Currituck County. I am thoroughly familiar with the tidal sections in this country, and I want to say to you that the influences that lower the tides in the Albermarle & Chesapeake Canal lower alike the tides in the Pasquotank River. Our North Carolina sounds act like a siphon; when the wind is from the north or northeast, of long duration, the water driven by the wind from the northern section of Albemarle Sound and the rivers emptying into Albemarle Sound is driven through the Pamlico and Roanoke Sounds and creates high tides. The same influences which lower the tides in Albemarle lower the tides in Pasquotank; the same influences that raise the tides in one raise them in the other. The tides, as I have said, act like a siphon. We are not under the influence of the ocean tides at all. The tides are acted upon entirely by the wind.

Currituck County has not sent a delegation here to worry the board about where the inland waterway shall go. We realize that eastern North Carolina and the whole United States needs an inland waterway. We have not got a delegation to show why it should be cut through Albemarle & Chesapeake Canal. I want to say that all the agricultural values are not right in Pasquotank and Elizabeth City. I want to say that land values in Currituck, through which the Albemarle & Chesapeake Canal passes, have increased tenfold in 10 years. Agricultural lands that you could buy for $10 an acre 10 years ago you can not buy at $100 an acre.

We have not any incorporated towns in the county, but we have a progressive, hardworking, economical county, that is progressive along agricultural lines.

Our county is willing to leave that question with the great Government and with the board.

J. J. Woodley (Washington County). I am from the south side of Albemarle Sound. I would like to be heard, if you can bear with me a little.

I may start from home. Education has caused the agitation, and the agitation is crying for fear. We can even go down to Roanoke Island, and when you disturb that you can distribute agitation to know for why he is disturbed.

Our people are greatly disturbed, and well they may be. It reminds me, when I look at the city of Elizabeth City, with her ornaments, as on the banks of the Nile, what is the matter? Your honorable board, we have reached these things 1,200 years before Christ come. When they would have no floods down the Nile they thought it was something that they had done with the Deity, that the Deity was displeased with. They did not go and take off the lowest of them for a sacrifice, but some lady of high birth, some Coptic maiden that stood high—nothing against her character, because she must be pure. She would dress in her finest apparel, her jewels all upon her, but with her arms tied down to her side and her ankles in fetters.

What is the matter to-day? When I look on the other side, I see old Aunt Dare standing by the side of the Pasquotank, with her ornaments on her, and, with all her failures for the last 50 years, she has been growing and growing greater.

I say she is bound to your honorable board to-day to say whether she shall be cast down, and I pray God you will look on her with an eye of pity and say whether she shall be cast down or lifted up. We will give her an outlet, and her outlet shall not be closed, and we will give her a better one. She needs it, she deserves, and I say it is expedient that she has it.

We need it also up in my county; we are petitioning the Government to give us an opening also. We have, like the Dismal Swamp land, the finest lands in the world. I can agree with Mr. Lindsey and the other gentleman. The gentlemen from Washington City say we have the finest land that has been analyzed in the laboratory of chemistry in Washington City. We have the resources, and we want them developed. We want your honorable board to think upon us and think upon us justly and kindly, and with the help of God to relieve us of the burden that we have been carrying. We are taxed with heavy freights, we are taxed with long routes, and we want them thrown off.

What made Rome great in the days of her greatness? I am not speaking to people who don't know. It was her national highways. What made Napoleon so victorious in his day? It was his great national highway that he could pounce down upon his enemy with swift dispatch and destroy them before they got ready. That is what will make us people great when you open up the ways so we may have facilities for communication with all people. We did not want to get into the fight. We are not working for one canal or for the other. I have no interest in either canal, nary a dollar, but I say open it up and let us have the cities connected together, where we can have something valuable, earned by all. What good would it do to build a great highway across the barren sands of Sahara, when there is nothing to carry, just for the sake of building a highway? What is the use in going through the sound when we do not come in contact with a place of importance until we reach Newbern? Let us go by Elizabeth City where we come in contact with the cities that will grow up like magic. If you do, your honorable board, we will thank you. If you do not, we will say the ode about Elizabeth:

> Sad, sad, will be your sadness,
> But glad, glad, will be your gladness.

If you only make her glad by saying "this is not the route; we will not cut you off, but will hold you."

We thank you for your earnestness and the time you have given us, hoping you will look upon us favorably, and may God bless you.

Mr. Harvey M. Dickson (Norfolk). Gentlemen, I am not representing any interest in either one of the canals, and I have no particular interest in either city. I am, however, in dead earnest in regard to the Atlantic waterways proposition from Cape Cod to Beaufort.

I believe the engineers in the service of the United States Government are thoroughly capable of determining which is the best route to recommend. I do not believe that they are going to do any injustice to any section of this country.

I do not want to see, however, the project blocked by attacking either local or personal interest.

I have just returned from the convention at Providence, and I want to say to you, Mr. Chairman, it is surprising the number of communities, the number of small streams, and the number of people who are clamoring for canals and rivers to be changed to go by their doors. If the board of engineers that the Government has so wisely designated to locate this route is going to be influenced by any locality or any conditions other than laid down in the act of Congress, we will never have a free waterway. My only interest is in a free waterway. The whole country needs it. Not only Elizabeth City—I may say that she deserves a great deal of consideration for the interest she has taken—but at the resolution committee meeting in Philadelphia last May personal interest entered so largely into it that one man had the audacity to introduce a resolution proposing that work should begin immediately on the Delaware Canal. Immediately when the resolution was introduced 50 resolutions were introduced looking to the improvement of each special section from Cape Cod to Beaufort.

I see if we do not bury our personal interest and our local interest we will never get a free waterway.

I believe the people on the Dismal Swamp Canal should not be cut out, but I do not believe that the United States Government is going to buy two canals and operate two canals. I believe, even if the engineers would recommend it in this district, that forthwith there would be loaded on this proposition so many canals and rivers and so many improvements that it would cost more than the Panama Canal.

I believe that this matter should be left to the engineers; I believe that they should hew to the line and let the chips fall where they may. If it hurts Norfolk, it must hurt Norfolk; if it hurts Elizabeth City, it must hurt Elizabeth City. The intention and purpose of the Atlantic Waterways Association is to give a deeper waterway from Cape Cod to Beaufort, and to adopt the most feasible, practicable, and economical route. I believe the engineers the Government has put on this work are capable of it.

Col. Abbot. Is there anybody else to be heard? [No response.] I wish to thank everyone who has been here present to-day for the assistance that they have given the board in their earnest endeavor to get at the bottom facts, upon which we must make a decision, the importance of which we all appreciate. I thank everyone who has spoken to-day, and I thank all those who have come to support by their presence those who were put up to speak for their interests. The meeting is adjourned.

Exhibit A.

	Weight.	Masters' service in 2 canals.	Better water.	Quicker route.	Uniform depth.	Avoid Currituck Sound.	Better service.	Remarks.
Barges.	*Tons.*							
S. A. Sands	277	11	*					Convenient, straight.
Jupiter	346	6	*	*				
Atlas	392	13		*				Better waterway.
Mars	312	10				*		
Carolina	333	18				*		Better route, protected, can perform better service.
Emily Schofield	243	15	*					
Emma and Bessie	381	25				*		Convenient, communication and supplies.
Berks	379	15	*				*	Better route, protected.
Larmie	308	28	*					Less work.
John Smith	196	10	*					
A. McNally	417	10		*				
Keystone	402	20					*	Better route, protected.
Celest. McNally	441	31	*	*				
Vulcan	392	9	*	*				
Isabelle	428	4	*					Better route, protected, convenient.
Saturn	328	18						Do.
Mercury	337	7	*					Do.
Schuylkill	270	12	*					
D. E. McNaughton	357		*					Straight line.
Jos. O'Brien [1]	218	4						
Schooners.								
Edwin and Maud	178	10	*					Both routes needful.
Geo. Gaskins	13	30	*				*	
Flora Agnes	31	1			*			Better and more certain passage.
Cora Peake	234	3				*		
Eva D. Rose	104	10			*			Less obstruction; Elizabeth City an attraction.
A. Von Nivenheim	42	20					*	
J. M. Quillen	129	20			*		*	Do.
W. T. Parker	178	10	*				*	Better and certain passage.
Geo. T. Garrison	35	11				*		Safer.
Eloise	29	11				*		More convenient.
Three Poto	14	10						More convenient and safer.
N. C. Dreger	14	20				*		Elizabeth City an attraction.
Annie E. Webb	101	9	*				*	Less obstruction.
Jno. Q. Furguson	129	6	*			*	*	
Chas. A. Straw	215	10	*				*	
M. & A. Beswick	219	4	*				*	
W. J. Hagine	15	10	*				*	More convenient.
Louise	66	36						Has town at each end.
Levi H. Phillips	87	20	*				*	
Tugs.								
Henry Steel	79	7	*					Less injury to wheels.
Mascott	42	16						Better condition.
C. B. Reynolds	45	10			*			Safer route.
Helen	99	11				*		Convenient for communication and supplies.
G. G. Mott	46	11			*	*		
Parole	34	12	*	*			*	
Esherick	69	10				*		
Curtin	85	8						Better condition.
Columbia	90	6	*	*				Safer route.
Nettie	85	7					*	
J. J. Fleetwood	38	8						Approaches better; good country and towns.
Grit	30	8						Better navigation; convenient.
Freight steamboats.								
T. S. Taylor	271	10				*		
Annie	72	15						Protected route.
Teddie	43	35		*				
Dennis Simmons	200	15			*			Less delay.
Nita	41	20						Straight route; do better work.
T. A. Small	49	25	*			*		Approaches better.
J. C. Ritchie	175		*	*				Shorter.

[1] Prefers Albemarle & Chesapeake, lower tolls, better route, better canal.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

War Department,
The Board of Engineers for Rivers and Harbors,
Washington, D. C., December 12, 1911.

Sir: Having fully considered the report of the special board on the surveys made in compliance with the act of March 3, 1909, for the construction of a continuous waterway, inland where practicable, from Boston, Mass., to Beaufort Inlet, N. C., the Board of Engineers for Rivers and Harbors has the honor to submit the following report thereon.

The item of law ordering this investigation and other items affecting it are quoted in the report. The waterway is considered under five sections, viz: Boston to Narragansett Bay, Narragansett Bay to Long Island Sound, New York Bay to Delaware River, Delaware River to Chesapeake Bay, Norfolk to Beaufort.

BOSTON-NARRAGANSETT BAY SECTION.

Seven possible routes for a waterway through the Boston-Narragansett Bay section were considered by the special board. The results of the surveys showed that two routes were clearly superior to all the others, one terminating in Hingham Bay in Boston Harbor proper, the other in Plymouth Harbor. The Hingham Bay route has a summit level of 35 feet, requiring 4 locks. On the Plymouth Harbor route the waterway can be constructed with a 20-foot summit level, requiring 2 locks, but a sea level cut with two tide locks is practicable. The line of the two routes mentioned is identical from Narragansett Bay to a point near the junction of Taunton and Wenatuxet Rivers. Estimates are submitted for channels 18 and 25 feet deep and 125 and 200 feet bottom width by both routes. The opinions of State, county, and municipal authorities and commercial bodies and vessel owners were obtained as to the most desirable waterway, and almost without exception the preference was for the Hingham Bay terminus with 25-foot depth and 200 feet bottom width, although when maintenance is taken into account this is the most costly route and type of canal, roughly estimated to cost $40,047,000 for construction and $836,000 annually for operation and maintenance.

The special board reports that in Boston there was little evidence of a serious desire for any canal, while great interest was evinced by persons living or doing business near the Taunton end. A State commission created "to consider in what manner the Commonwealth may best cooperate with the Federal Government and certain other States in the development of inland waterways," reported that "The conditions of transportation may so change in the future as to make such a canal desirable and necessary, but the facts as they now appear do not warrant this commission in advocating the present construction of the proposed canal." This section of the Intracoastal Waterway is at the extreme northern end. Its principal object would be to

avoid the dangers incident to the outside passage around Cape Cod. The special board points out, however, that until the section immediately to the south is constructed, the dangers of open-sea navigation around Point Judith will have to be met by all vessels passing through the canal, and this would largely exclude the class of smooth-water coal barges, from the use of which most of the economies of transportation, via the inland canal, are to be expected. Another condition suggesting delay is the probable early completion of the Cape Cod Canal by private parties. This canal will have a depth of 25 feet and a bottom width of 100 feet.

The special board concludes as follows:

At the present time there appears to be no commercial necessity sufficient to justify the construction of a canal over either of these inland routes. After other sections of the proposed intracoastal waterway have been constructed and after the measure of relief to commerce to be afforded by the Cape Cod Ship Canal has been demonstrated, the question of the need for a completely sheltered waterway between Narragansett Bay and Boston should receive further consideration.

The economic value of the Cape Cod Canal with its exposed approaches has not yet been established. It is not considered advisable for the United States to enter into any negotiations looking to the acquisition of this canal at the present time. After its completion the question of its acquirement, based on its value as a "going concern," may be worthy of further consideration.

The Board of Engineers for Rivers and Harbors concurs in the view that the construction of this section of the proposed intracoastal waterway is not worthy of being undertaken by the General Government at the present time.

NARRAGANSETT BAY—LONG ISLAND SOUND SECTION.

This section of the proposed intracoastal waterway is designed to afford protected navigation from Narragansett Bay to Long Island Sound. It extends from the west side of Narragansett Bay to Fishers Island Sound, following in a general way a natural route parallel to the southern coast of Rhode Island through valleys, tidal ponds, and across low divides within the towns of North Kingston, Narragansett, South Kingston, Charleston, and Westerly. The total length of the line between waters of 18 feet depth at the two ends is 35.6 miles. Several modifications of the route were surveyed, and the line selected as most desirable begins at Bissells Cove, in Narragansett Bay, and ends at Colonel Willies Cove, in Little Narragansett Bay. The estimates are as follows:

Sea-level canal, Bissells Cove to Fishers Island Sound, depth 18 feet; bottom width, 125 feet in land cuts and 250 feet in ponds and approaches, with an auxiliary entrance at the mouth of Narrow River, 18 feet in depth and 100 feet bottom width, with protecting jetty extending to 20 feet depth of water at mean low tide in Narragansett Bay, $12,322,000.

Sea-level canal, Bissells Cove to Fishers Island Sound, depth 25 feet; bottom width, 200 feet in land cuts and 300 feet in ponds and approaches, with an auxiliary entrance at the mouth of Narrow River, 18 feet in depth and 100 feet bottom width, with a protecting jetty extending to 20 feet depth of water at mean low water in Narragansett Bay, $24,736,635.

If the State bears the cost of road changes and land damages, the cost to the United States will be reduced $590,000 on either of the above projects. With its eastern entrance just north of Narragansett Pier, instead of at Bissells Cove, the cost of the 18-foot canal is placed at $11,399,205 and the cost of the 25-foot canal at $21,864,000,

but on account of the exposed entrance and the reach of open water between it and the protected waters of Narragansett Bay this terminus was rejected by the special board. The cost of maintenance is estimated at $160,000 annually.

The commerce of the Newport Engineer district during the calendar year 1908, to and from localities under improvement by the United States, is reported at 6,587,177 tons, valued at $215,009,093, of which 4,587,763 tons, valued at $26,073,351, was coal and other fuel. The commerce entering and leaving Narragansett Bay was 4,949,262 tons, valued at $170,944,159, while that carried to and from points east of Narragansett Bay was 1,637,915 tons, valued at $7,574,492. It appears that tows of barges coming through Long Island Sound and bound for Narragansett Bay are frequently detained a considerable time at the eastern end of the sound, and at Newport in returning, awaiting favorable weather to make the passage. The delays at times amount to a week or more. By increasing the time of transportation they reduce the number of trips made and the amount of commerce carried and render necessary a higher freight rate than would be required through a protected route to afford a reasonable return on the investment. The passage through the exposed portions of the route requires from 12 to 15 hours. Changes of weather conditions during this time of transit have caused the total loss of many box barges, and the special board believes that the elimination of this marine risk would permit a considerable further reduction in freight rates. Looking to the future and assuming the construction of waterways from Chesapeake Bay to Delaware River, and from Delaware River to New York Bay, the Rhode Island canal would afford a protected way which would permit the use of light types of barges and towboats for transportation of coal from Philadelphia, Baltimore, and Norfolk to Providence and other Narragansett Bay points, in lieu of the expensive barges and seagoing tugs now used in this trade. At present the railroads practically control the freight movement between New York and Narragansett Bay, this being due to a number of causes, among which are their control of the deep-water terminals and the large capital required for the type of boat needed. A protected waterway would diminish the investment required in ships, thus stimulating competition. The question of supplying greater public wharf space has already been taken up by the municipalities of Providence and New York.

The opinions of transportation interests are generally in favor of the proposed waterway. Some unfavorable views, however, are quoted by the special board and include statements from the Board of Underwriters of New York, and the Central Railroad of New Jersey. The special board states that "the objections offered to the construction of the proposed canal seem to be based on the theory that the existing means of water transportation are better adapted to existing routes than they would be to a canal, without consideration of the benefits to be derived from the development of an efficient type of vessel, especially suited to canal transportation, a vessel of low cost as compared with those built for service on the ocean." The depth of the canal has been placed at 18 feet to accommodate freight carriers drawing from 14 to 16 feet. Deeper draft vessels can take the outside route with safety.

The special board recommends the construction of a canal 18 feet deep, at an estimated cost of $12,322,000, but it states that "the full benefits to be derived from this section can be obtained only after the completion of the sections to the south, and initiation of work should follow that on the New Jersey section." It appears that the State of Rhode Island has undertaken to provide a free right of way for the canal, as far as an appropriation of $500,000 will permit, and the special board recommends that the State be requested to take such further steps as may be necessary to change the location of highways and roads as outlined in the report, the cost of the bridges only to be borne by the United States.

The Board of Engineers for Rivers and Harbors is unable to take as favorable a view as that expressed by the special board relative to the commercial benefits to be expected from this waterway. It affords practically no saving in distance over the outside route, and boats would probably prefer the latter except in stormy weather. This appears to be the least needed link in the waterway from Boston to Beaufort. The tonnage as given in the special board's estimates is much less than in the section adjoining Boston, and the exposure of the outside route is also less. It is very questionable whether the inside route would be used sufficiently to warrant the large expenditure required for its construction and maintenance. The board, therefore, not only concurs in the view that the construction of this section of the Intracoastal Waterway should not be undertaken at the present time but also believes it is inadvisable to commit the Government now to a definite project for its execution at any future time. Accordingly the board does not recommend approval of this section or any procedure by the State of Rhode Island in connection with the right of way.

NEW YORK BAY—DELAWARE RIVER SECTION.

All practical routes for this section of the proposed Intracoastal Waterway were considered by the special board, and an investigation was made of the existing Delaware & Raritan Canal with a view of determining whether this canal could be altered and adapted to modern requirements. The main canal now has a surface width of about 80 feet, a bottom width of 50 feet and a depth of 9 feet. The depth on the miter sills of locks is 7½ feet. The canal is crossed twice by the main line of the Pennsylvania Railroad at points where the conditions render it impracticable to make the necessary changes of grade without enormous expense. At Trenton it is also crossed by 11 draw bridges. The interruptions to street traffic by the small existing canal navigation are a cause of annoyance and loss to both land and water commerce, and with an enlarged canal carrying a heavy commerce the conditions would be intolerable. For these and other reasons the special board decided that the adoption of this line would not be economical or advantageous. Another line considered was that recommended in 1895 by a committee appointed by the city of Philadelphia. This route extends from Bordentown to the Raritan River near its mouth, and was rejected by the special board, after a rough survey had been made of it, because of the many railroad crossings, the rock formation encountered, and the greater cost as compared with a similar canal on a route farther east.

The route selected as most desirable runs from Bordentown, N. J., in a general northeasterly direction to Raritan Bay at the town of Morgan. The length of the line across New Jersey is 33.7 miles. The route is suitable for a sea-level canal or for a lock canal, having a summit level of 70 feet. The special board believes that the canal, to have commercial value, should have a bottom width of at least 125 feet. The question of the most advantageous depth was considered, and the opinion reached that a canal which would join the North and South Atlantic seaboards and connect directly two cities of such great importance as New York and Philadelphia, if worth building at all, should have dimensions sufficient to permit boats of from 2,000 to 3,000 tons capacity to traverse it at a fair rate of speed. A boat of the latter capacity would draw about 16 feet loaded, and a depth of at least 18 feet was therefore considered essential. It was found, however, that the difference in the estimates of cost for canals 18 feet and 25 feet in depth was comparatively small, and, moreover, it was thought that if the canal should be constructed with an 18-foot depth there would be within a few years an imperative demand for an increase of depth. The special board therefore recommends that the canal depth should be fixed at 25 feet and that the approaches in New York Bay and in the Delaware River, as far as Bordentown, should have channels with a central depth of 25 feet for a width of 100 feet, and a depth of 18 feet for a width of 300 feet. It is proposed also to construct a branch channel in the Delaware River from Bordentown to Trenton, having a depth of 18 feet for a width of 150 feet.

The time required to pass through a sea-level canal would be less than through a lock canal, and the former type is advocated almost unanimously by commercial interests. Considering the cost of water supply for a summit-level canal and the expense of maintenance, the estimates made by the special board show but little difference between the cost of the two types, and the board therefore decided in favor of the sea-level canal. The total cost of a sea-level canal 25 feet deep at extreme low water and 125 feet wide, with approach channels as described above, is estimated at $45,000,000, and the cost of annual maintenance at $312,217. The State of New Jersey has undertaken to expend not to exceed $500,000 toward providing a right of way for the canal.

The commerce to be benefited by the proposed waterway is of great magnitude and importance. Not only will the canal afford a protected route for the commerce passing between the two great industrial centers of New York and Philadelphia, but also for the commerce of many miles of waterways south of Philadelphia and north of New York. Other benefits and advantages claimed for this section of the waterway are the utilization of economical types of boats in place of the expensive vessels and barges now used for the transportation of coal and lumber northward via the outside route, where many disasters to shipping and heavy loss of life and property have occurred; the large direct saving in cost of transporting heavy commodities, and the indirect saving due to the influence of the waterway on rail rates; the amelioration of the congestion of traffic which frequently exists on the rail lines in this vicinity; the affording of an additional avenue for the transportation of necessities of life to the important cities

concerned, reducing the liability of suffering and loss from physical, commercial, or political disturbances. It is estimated that the annual commerce on this waterway for the first few years would amount to about 5,600,000 tons, and that there would be an average saving in freight rates of about 40 cents per ton.

In conclusion the special board recommends a sea-level canal 25 feet in depth; but it believes "that the construction of this section of the canal should be deferred until after the construction of the two more southerly sections, and until the United States plant now at work in the Panama Canal shall be made available."

The Board of Engineers for Rivers and Harbors considers it improbable that the commercial benefits of this deep-draft sea-level canal across the State of New Jersey would be commensurate with the very large expenditure proposed. The total length of the channel to be constructed, omitting the Trenton spur, is about 71.8 miles. Even assuming the estimate of 5,600,000 tons of commerce through this channel, the interest at 3 per cent on the cost of construction and the expense of maintenance would amount to about 30 cents per ton, or 4 mills per ton-mile, which is a heavy charge for the public to assume for the benefit of shippers. The apparent advantage of the canal over a double-track freight railroad, shown by the special board, is based on the use of both to their maximum capacity, viz., approximately 100,000,000 tons per year for the railroad and 1,280,000,000 tons for the canal. For the expected traffic of 5,600,000 tons, or even for a considerably larger tonnage, this advantage would disappear. The principal estimates for a saving by the inside route are based on calculations for 1,000 and 2,000 ton barges, and either of these can be accommodated on a depth of 12 feet. * * *

This board concurs with the special board in the opinion that the value of the New York Bay-Delaware River section is largely dependent on the opening of communicating waterways to the south. The recommendation that its construction be deferred until after the completion of the two more southerly sections, and until the United States plant now at work in the Panama Canal shall become available, necessarily involves postponement for a number of years, during which time commercial and transportation conditions may undergo changes affecting more or less the present findings. Accordingly this board does not recommend the present adoption of a project for a 25-foot canal in this section. Furthermore, it is not convinced that a canal of much less depth would not adequately meet the demands of commerce, and believes that estimates of the cost of a canal 12 feet deep should be secured, which can be done without additional congressional action. Pending such investigation, action by the State of New Jersey with a view to changing the location of highways and roads and authorizing changes in railroad locations should be postponed.

DELAWARE RIVER—CHESAPEAKE BAY SECTION.

The construction of a ship canal connecting Delaware River and Chesapeake Bay has heretofore been considered by the General Government as an independent proposition. Communication between

these two bodies of water for light-draft boats is now afforded by the Chesapeake and Delaware Canal, a private waterway charging tolls. The canal is 36 feet wide at the bottom and 10 feet deep, 13.5 miles long, with a summit level of 16 feet, and contains three locks 220 feet long by 24 feet wide in the clear. Due to its restricted dimensions and the tolls charged for its use, the commerce through it is not proportional to that of the bodies of water which it connects.

All possible routes were considered by the special board, and for reasons fully explained, the opinion was reached that the most available route lies substantially along the line of the present Chesapeake and Delaware Canal, and a survey of this route was therefore made. The present terminus of the canal at Delaware City is not well adapted to enlargement, and the plan presented provides for a new entrance at Reedy Point, though retaining the Delaware City arm as a branch canal for the use of light-draft boats. From the point of junction of the new entrance and the present canal, the proposed waterway follows closely the line of the existing cut. The law ordering this investigation prescribes 25 feet as the maximum depth to be considered. The special board states that this depth would permit nearly all of the coastwise water-borne traffic now plying between Baltimore and ports of the northern Atlantic coast, and also a large part of the foreign commerce of Baltimore with Canadian and European ports to use the canal advantageously. It is stated that a depth of 18 feet would permit few of these vessels to utilize the canal. The actual saving in first cost of the 18-foot canal as compared with the 25-foot canal is placed at about $700,000, and as this saving is not regarded as sufficient to justify the sacrifice of the benefits expected from the greater depth, final estimates are submitted only for the larger project. In considering the most suitable type of canal, the special board found that a tide-level canal would be cheaper to construct, operate, and maintain than a lock canal, on account of the large and expensive locks that would be required for the character of commerce involved, and the necessity of constructing a pumping plant to supply water to the summit level. No damage to banks or interference with navigation is apprehended on account of tidal currents, and it is thought that a guard lock will not be required. The estimates are as follows:

Tide-level canal 25 feet deep at mean low water, 125 feet bottom width	$9,910,210.00
Estimated value of the existing Chesapeake & Delaware Canal	2,514,289.70
	12,424,499.70
Initial cost of plant for maintenance	375,400.00
Annual cost of maintenance	104,220.00

The Delaware River-Chesapeake Bay Canal is an essential part of any through inland waterway connecting New York or Philadelphia with the South, and the enlarged canal would also be of value in connection with existing waterways and their commerce. It would enable many vessels bound to and from Baltimore to avoid the dangers of the outside route between Cape Charles and Cape Henlopen, where many wrecks have occurred; it would save a distance of 184 miles between the latter point and Baltimore, involving a substantial saving in cost of vessel operation; and as a result of economies effected in methods and routes of transportation it would produce a

considerable saving in freight charges. These savings for a free canal 25 feet deep, based entirely on existing commerce and from incomplete returns, are estimated by the special board to amount to $1,414,242 annually. In the opinion of the special board "the importance of this section is deemed sufficient to warrant the immediate purchase of the existing canal and the inception of work for its enlargement as soon as funds can be made available." Condemnation proceedings are recommended in case the holdings of the Chesapeake & Delaware Canal Co. can not be bought for $2,514,289.70 or less.

The Board of Engineers for Rivers and Harbors concurs with the special board as to the desirability of a free waterway connecting Delaware River and Chesapeake Bay. Aside from its future value as a link in a through waterway connecting northern and southern ports, it will be of great value to existing commerce, and will yield immediate benefits. The board therefore recommends the purchase of the Chesapeake & Delaware Canal at a price not exceeding $2,514,289.70, or its acquirement by condemnation proceedings if necessary. It believes that the question of the enlargement of this canal should receive further study with a view to determining whether a less depth than that proposed by the special board would not adequately meet the requirements of commerce and navigation, and recommends the preparation of an estimate of the cost of a 12-foot canal, which is the depth recommended by the special board, as well as by this board, for the Norfolk-Beaufort section. This can be done under the present authorization.

NORFOLK-BEAUFORT SECTION.

For convenient consideration the special board separates this section of the intracoastal waterway into three divisions: First, Norfolk to Albemarle Sound; second, Albemarle Sound to Pamlico Sound; third, Pamlico Sound to Beaufort Harbor.

Norfolk to Albemarle Sound.—Protected navigation between Norfolk and Albemarle Sound was first afforded by the construction of the Dismal Swamp Canal, and later by the construction of the Albemarle & Chesapeake Canal. The fact that all commerce passing through these waterways was subject to tolls early attracted attention to the desirability of a Government-owned free waterway, and this question has been the subject of several reports and investigations. The most recent of these was made in compliance with the act of March 3, 1905, which ordered an examination of the Norfolk-Beaufort waterway. The report recommended the construction of a 12-foot waterway between the points named. The improvement of the part between Pamlico Sound and Beaufort Inlet to a depth of 10 feet was adopted by the act of March 2, 1907, and the canal has been built.

Four routes for the Norfolk-Albemarle Sound division are considered possible and practicable by the special board, as follows: (1) The Dismal Swamp Canal route; (2) the Albemarle & Chesapeake Canal route; (3) the Cooper Creek route; (4) the New Cooper Creek route.

Route No. 4 is a modification of Route No. 3. It appears that there is no source of water supply which would be adequate for a lock canal with a summit level, unless costly pumping plants be installed, and for this and other reasons the special board believes

that the waterway should be a sea-level canal. The plans submitted are for canals 12 and 16 feet deep, having bottom widths of 90 feet through dry land, 125 feet in narrow parts of rivers, 250 feet in wide portions of rivers, in bays and entrances to them, and in Currituck Sound, and 300 feet in open sounds and across bars in North River. The estimates are as follows:

Route.	Depth, 16 feet.	Depth, 12 feet.
1. Dismal Swamp Canal route	$7,072,600	$5,601,520
2. Albemarle & Chesapeake Canal route	4,178,930	2,733,300
3. Cooper Creek route	5,326,000	4,008,520
4. New Cooper Creek route	5,100,100	3,792,520

The above estimates for routes 1 and 2 include the cost of acquiring the existing private canals, which is $1,750,000 for the Dismal Swamp Canal and $500,000 for the Albemarle & Chesapeake Canal.

The act of June 25, 1910, authorizes the Secretary of War to enter into negotiations for the purchase as a part of the inland waterway of the Albemarle & Chesapeake Canal, or the Dismal Swamp Canal, and to make a contract for the purchase of either of said canals and appurtenances, subject to further ratification and appropriation by Congress:

Provided, That no contract for the purchase of either of said canals shall be made unless such purchase, after full hearing of all parties in interest, is recommended in the survey report to be hereafter submitted in compliance with the directions of Congress in the river and harbor act approved March third, nineteen hundred and nine.

A hearing was given by the special board at Norfolk on September 6, 1910, and a careful study of the advantages and disadvantages of the several routes has been made. The conclusion is reached that the most desirable route is that via the Albemarle & Chesapeake Canal, and recommendation is made that this route be selected and improved by the United States to a depth of 12 feet:

Provided, That all property and rights of the Albemarle and Chesapeake Canal can be acquired for not exceeding five hundred thousand dollars.

Albemarle Sound to Pamlico Sound.—A number of routes were considered for the stretch from Albemarle Sound to Pamlico Sound, and estimates are given as follows:

Route.	Depth, 16 feet.	Depth, 12 feet.
Croatan Sound	$2,372,000	$183,320
Long Shoal	2,912,000	1,782,560
Far Creek	3,006,000	2,031,420
Juniper Bay	4,099,000	2,556,640
Rose Bay	3,441,780	2,216,780
Pungo River	3,287,000	1,535,800
Modified Pungo River	3,390,000	2,077,200

The estimates for the Long Shoal, Far Creek, and Juniper Bay routes each include $1,000,000 for the cost of a necessary harbor of refuge at Pamlico Sound entrance.

After consideration of all the engineering and commercial factors involved, the special board recommends that a depth of 12 feet be

given this section of the waterway and that the Rose Bay route be adopted. While the cost of this route for the 12-foot canal is considerably greater than the Croatan Sound route, the conditions are more favorable for economical maintenance and for the enlargement of the canal if required in the future.

Pamlico Sound to Beaufort Inlet.—As stated above, this section is now under improvement by the United States to a depth of 10 feet, and the special board recommends that the channel be deepened to 12 feet at mean low water at an estimated cost of $397,500, conforming to the depth recommended for other divisions of this section. The dredging of Brant Shoal to a similar depth, in order to afford the necessary connection between this stretch and the one immediately north, is also recommended at an estimated cost of $54,000.

Some of the reasons which influenced the special board to recommend the 12-foot depth at the present time for the Norfolk-Beaufort section of the intracoastal waterway are as follows: This depth is at least as great as that available at all the North Carolina shipping points to and from which practically all the local commerce will be carried; it is greater than that now available in existing inland waterways south of Norfolk; it will be sufficient for boats and barges much larger than those now in use and large enough to permit the economical handling and transportation of cargoes of the class that will probably be carried on the waterway; it is sufficient for the smaller vessels of the Navy and for many sound, bay, and river steamers which might be used as transports; and under the plan proposed a greater depth can be readily and economically provided if in future the needs of commerce justify such enlargement.

The estimated costs of the improvements proposed in this section are summarized as follows:

	12-foot depth.
Norfolk to Albemarle Sound: Albemarle and Chesapeake Canal route	$2, 733, 300
Albemarle Sound to Pamlico Sound: Rose Bay route	2, 216, 780
Brant Shoal Cut	54, 000
Pamlico Sound to Beaufort Inlet via Adams Creek Canal	397, 500
Total	5, 401, 580

The special board recommends a 12-foot canal along the above route and expresses the opinion—

that the commercial necessities in this section, as well as the comparatively low cost of the canal, warrant the immediate purchase of the Albemarle and Chesapeake Canal and the inception of work on the enlargement and extension recommended without delay.

In connection with the purchase of this canal the special board states:

Attention is especially invited to the fact that if the above recommendation of the board be approved, and if the Albemarle and Chesapeake Canal be purchased by the United States, the business of the now competing Dismal Swamp Canal will probably be practically ruined. While it is understood that for such indirect damage done to the canal company it has no legal redress, it is thought proper to invite the attention of Congress to the condition which will then exist.

As stated above, a project for a 12-foot waterway between Norfolk and Beaufort was recommended in a former report on this subject. At that time, as well as in all previous discussions, this portion of the intracoastal waterway was considered as a separate proposition, but now its importance to general through commerce is

enhanced by reason of the possible development of a free waterway affording protected navigation at least as far north as Delaware River. As stated in its former reports, the Board of Engineers for Rivers and Harbors considers it extremely doubtful whether any considerable portion of the ocean-borne commerce between north and south Atlantic ports will be diverted to this inland route. The inland route, however, now carries a commerce of importance, though it is hampered by tolls, and, with the enlarged free canal now proposed, increased commerce and widespread benefits are to be expected. For these reasons, this board concurs with the special board regarding the advisability of the construction of a waterway 12 feet in depth between Norfolk and Beaufort Inlet. In connection with its study of this matter the board made an inspection of the Albemarle & Chesapeake Canal and the Dismal Swamp Canal and held advertised hearings at Norfolk and Elizabeth City, at which all parties having an interest in the subject under discussion were afforded opportunity to be heard. The conclusions of this board regarding the most desirable route coincide with those of the special board, and it is recommended that the necessary steps be taken for the immediate purchase of the Albemarle & Chesapeake Canal and for the completion of the Norfolk-Beaufort section of the intracoastal waterway in accordance with the project proposed by the special board, at an estimated cost of $5,401,580.

The special board discusses the military and naval uses of an intracoastal waterway. The Board of Engineers for Rivers and Harbors has carefully considered these features and recognizes the benefits that such a waterway would afford in these respects. It does not appear, however, that these benefits are such as to warrant any modification of the conclusions expressed above.

In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board.

Very respectfully,

Wm. T. Rossell,
Colonel, Corps of Engineers,
Senior Member of the Board.

The Chief of Engineers, U. S. Army.

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